DIESEL TECHNOLOGY

HEARING

BEFORE THE

SUBCOMMITTEE ON
INVESTIGATIONS AND OVERSIGHT

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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DIESEL TECHNOLOGY

THURSDAY, MAY 6, 1982

House of Representatives,
Committee on Science and Technology,
Subcommittee on Investigations and Oversight,
Washington, D.C.

The subcommittee met, pursuant to call, at 9:05 a.m., in room 2325, Rayburn House Office Building, Hon. Albert Gore, Jr. (chairman of the subcommittee) presiding.

Mr. Gore. The hearing will come to order.

I would like to thank everyone for coming out at an hour that is earlier than hearings usually get started in this building, and I would like to say good morning and welcome to everyone. This subcommittee often experiences an interesting phenomenon. Whenever we attempt to examine or educate ourselves about subjects that appear to be rather benign, it never fails that controversy lurks beneath those still waters of public policy. That is the case with respect to this rather dry subject, also.

At the request of my friend and colleague from Pennsylvania, Bob Walker, the Science and Technology Committee conducted hearings last Congress to examine the relationship between diesel emissions and health effects. While some questions remain unanswered as a result of those proceedings, I believe it is fair to conclude that there is no fundamental disagreement about diesel emissions—they are not good for you.

Since this is true, we thought it wise to turn our attention to the possible technological solutions to the problem of diesel emissions, as well as the science behind formulating our regulatory policies.

Thus, we anticipate that our proceedings today will delve into the following issues:

First, it appears that there is a very wide range in the predictions concerning the number of diesels we can expect to see in the future on the road. This is certainly a dilemma. Without this rather basic coefficient, it is difficult to evaluate the impact of diesels and intelligently design diesel policy.

Second, there seems to be a fair amount of disagreement about the state of the art of control technologies. To some observers, they have arrived. To others, there is a much longer row to hoe.

And lastly, there is the interesting "chicken and egg" relationship between the regulations themselves and the technology. Do the regulations create the technology, or should the technology determine the regulations?

I am hopeful that proceedings like this one will help to put the controversies on the table, and give us a balanced view so that any regulatory decisions are based on intelligent assumptions and sound scientific judgments.

We thank all the witnesses for taking the time and effort to appear here today.

I think we often make greater progress by examining the complicated issues before they involve enormous economic stakes and political controversies. If we can resolve some of these technological controversies before they are full-blown, I think we save time and effort. For that reason I particularly appreciate the fact that these witnesses have come here to help us create this record today.

Our first panel consists of three witnesses, Mr. Arvid Jouppi, with Arvid Jouppi Associates, David Doniger, counsel with the Natural Resources Defense Council, and Mr. Michael Walsh, a consultant and former Director of Mobile Source Air Pollution Section of EPA.

If the three of you will come to the witness table, we will get the hearing underway.

We will proceed from left to right. I want to welcome each of you and again express our thanks to you for helping us in this endeavor.

Mr. Jouppi, would you please begin.

Without objection, your prepared statement will be included in full in the record, and we invite you to proceed with the presentation of it. If you want to summarize any portion of it, that is fine, too.

STATEMENTS OF ARVID JOUPPI, ARVID JOUPPI ASSOCIATES; DAVID DONIGER, COUNSEL, NATURAL RESOURCES DEFENSE COUNCIL; AND MICHAEL WALSH, CONSULTANT (FORMER DIRECTOR, MOBILE SOURCE AIR POLLUTION CONTROL, EPA)

Mr. Jouppi. Thank you very much, honorable members of the subcommittee, and of course I am delighted to be here, primarily as a financial analyst, and I might say that this is not a benign issue, because the issue goes all the way into evaluation of the stocks, and it goes all the way back into the formation of equity capital to keep the industries going an so forth, so it really is a rather complex thing, and I was delighted, Mr. Chairman, with the way that you set forth the format here so that we can get at it, and I just hope that I can provide a few things that might be helpful.

As far as the—let us take just a quick look at the market, get to that initially. Right now the automobile market is in a pit. It went back into a pit only in April; actually we thought we had some improvement in January, February, and March. The seasonals were good in that period. Now we have gone back down to a below 5 million annual rate in April.

And leaping way over into about 1990 and directing ourselves specifically to this issue, where will the diesels be at this particular time, I have felt right along that diesels would not come along quite as fast as many people felt that they would, cutting through many, many different things and trying best as we are able to integrate them. We would place diesels in 1990 to be running not 20 percent of the fleet, but running 20 percent of production in that particular year production, plus sales from overseas. In other words, if that turns out to be a 12 million year, one could expect 20 percent of them might be diesels. Not 10, not 30—that seems to hit about right.

We have had in the past many thoughts that out 5 years from now, 10 years from now, we might have a major change in power supply, and I think particularly of the rotary engine, which many in my community, Wall Street, felt by this time that we would be running 80 to 90 percent rotary, and of course we are not. The turbine engine did the same thing in an earlier decade. So that it seems to me that we should prepare ourselves as a great Nation from a policy viewpoint for many different contingencies. I think we need to start with the fuel availability, and roughly 35 percent of the crude barrel is suitable for diesel. If you go above say 50 percent, it is my understanding from the oil people that you run into the point of diminishing returns, that your diesel fuel would become more costly than gasoline.

Mr. GORE. May I interrupt you? Diesel fuel is more costly than gasoline now in my part of the country, and I assume in some other parts of the country. Why is that? Do you know the short answer to that?

Mr. JOUPPI. The short answer is that the crude cost is only part of the cost. You have your refinery costs, distribution costs, and the marketing costs and so forth, and the distribution industry—I am talking now about the total marketing to get it into one's tank—is a very complex equation, and the oil companies I believe are having difficulty in predicting precisely where the pumps should be and so forth, so there is an added cost. This is my explanation of it.

Mr. GORE. My own impression is that first of all stocks are very low, historically quite low on diesel stock. Second, that with the world oil glut, the first purchasers are able to select a higher mix of the light crudes. Third, that the continued technological advances in the refining sector have led to an introduction of new refining techniques that produce a higher percentage of the light mixes, the light products from the back end of the refinery. And finally, that with decontrol the diesel market, which is a discrete market, is more subject to this kind of pricing, and I think all of those factors have produced this new development of diesel being higher than gasoline. I have a lot of farmers that say this is unheard of. Excuse me for interrupting.

Mr. JOUPPI. Thank you for interrupting, because it is a complex thing, and as far as the new technologies in the refineries, this issue goes to the refineries and the oil products. Until there is a firm understanding as to what the need will be, the refineries really will not know which way to go.

Mr. GORE. And presumably the higher percentage growth of diesel engines in the marketplace in the past was at least in part due to the fact that people kept noticing that diesel prices were lower than gasoline prices, and if they notice that they are higher than gasoline prices, the demand for diesels may be substantially affected.

Mr. JOUPPI. Mr. Chairman, that certainly is true, and I have addressed myself to that subjectively at least, and I have felt that $1.50 per gallon might be a break point, that if gasoline prices were to go to $1.50 a gallon—it is closer to $1 now—then to the $2 that we had expected here 18, 20 months ago, looking forward to that point, that the $1.50—and that is an arbitrary number, I could as easily live with a number somewhat lower than that—if gasoline prices were to move to that level with the advancing technology as we see it in the laboratories of the car companies, et cetera, it would seem that we would tend to add to the dieselization of the total fleet, which is as far as cars are concerned, it is about 108 million right now. As gasoline comes below that, then there seems to be a desire on the part of the American buying public to move at this moment, in 1982, back to somewhat larger cars, and the fuel cost does not become as large a percentage of the total operating money that is needed to run the automobile. So there is something to that dollar and a half, and I have it on page 3 of my testimony.

We have already covered this 20-percent idea, and that is objective as to whether it would be 20 percent or some other number. And I think I can reasonably justify 20 percent. There are many facets to the matter that you are considering, and I do believe that it is, in addition to health, which I really have not considered because I am not qualified to do so, and I know that you will be looking into that—there are so many other aspects to this thing, and one is the use of the—the best use of a $800 billion highway system, which is a tremendous national asset and would become very, very important in the case of military situations and so forth.

Now we move into the truck area, and you have diesel fuel there. Diesel fuel there of course is extraordinarily important, because it enables truck operators to deliver the freight at less cost to the consumer than gasoline. So that there is an issue there. And my thought is getting to the specific of what the particulate ought to be, what the allowable content should be, and I think we are all aware that there is a one hand fighting the other when you consider reducing nitrogen oxides and reducing particulates. That I am sure others will get into.

And coming to the real issue—I have had to make up my mind—where would I, if I had my little vote on national policy, I would not go to the 0.2 gpm particulate standard at this time because integrating everything—and I am thinking of the available technologies, and I might say this, that the manufacturers, and I have touched base with every one of the majors—and at the engineering level, not at the finance level, which is my usual entry to these companies—it would be extremely, extremely difficult for them to get 0.2, in some cases I would say impossible.

Nevertheless, getting to the role of the Government, it seems to me that the role of the Government ought to be to push as hard as possible toward a lower level, because, Mr. Chairman, as you mentioned at the beginning, nobody likes the emissions, and we really do not know as much as we will in perhaps some future generation about what these emissions will do. I just feel that we ought to go to a standard of maybe 0.35 gpm as the letter of invitation specifically asked what would be the attitude of the witness, and that is the number that I set forth.

Interestingly, I do not find anywhere in Europe or Japan any kind of technology that is more advanced than ours. I have become very aware that sometimes we will say here, we cannot do it, and then we find that an importer has done it, and this of course is not good for the American market or for the American because generally, and it seems to me that we have a role here of being an industrial leader, and that we should be the standard-setter for the world. I had the opportunity to mention that in other hearings of this type. But we should not just seek to set a standard for ourselves, but since we are dealing with a world car, a world truck, a world highway system, then it seems to me the United States ought to accept clearly the obligation of becoming the world standard-setter and also to, by means of persuasion, diplomatic persuasion and other, to see that we do have a world standard, because without a world standard we cannot have a true world car.

I think at this point I could probably conclude my remarks.

[The prepared statement of Arvid Jouppi follows:]

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WORKSHEETS

May 6, 1982

Arvid Jouppi Materials in Preparation for Giving Testimony in Washington, D.C., 2321 Rayburn House Office Building, after 9:00 a.m., Thursday, May 6, 1982.

Appearance and Testimony Upon the Invitation of and For the --

CONGRESS OF THE UNITED STATES, HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT of THE COMMITTEE ON SCIENCE AND TECHNOLOGY (RESPONDING TO INVITATION OF THE HONORABLE ALBERT GORE, JR., CHAIRMAN, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT. PARTICIPATING IN HEARING ARRANGEMENTS: JIM JENSEN OF THE SUBCOMMITTEE STAFF.)

Ninety-Seventh Congress

Members of the Subcommittee:

Albert Gore, Jr., Tennessee, Chairman
Robert Shamansky, Ohio
Robert Walker, Pennsylvania
Harold Volkmer, Missouri
Manuel Lujan, New Mexico

TIME AND DATE -- After 9:00 a.m., Thursday, May 6, 1982

PLACE -- Room 2321 of Rayburn House Office Building, Washington, District of Columbia 20515

Background -- The Subcommittee Chairman, The Honorable Albert Gore, in his letter of invitation, dated April 26, 1982, asked that this witness provide information on "recent technological developments in diesel powered vehicles;" on devices and technologies designed to control emissions and their resultant health effects. The letter also asked that "you discuss the future of diesel market penetration, foreign competition and government controls."

Arvid Jouppi Materials on Newly Emerging Diesel Technologies in Preparation for Giving Testimony in Washington, D.C., Thursday, May 6, 1982, before Subcommittee on Investigations and Oversight.

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Chairman Gore specifically asked for comments related to diesel penetration of the passenger car fleet, an analysis of whether proposed particulate standards could be met, a consideration of costs and remaining obstacles to technologies needed to meet these standards and comments on an appropriate role for the Government.

HONORABLE MEMBERS OF THE SUBCOMMITTEE:

Let me say from a background of fulfilling experiences, that I much appreciate this Subcommittee's careful concerns in weighing possible changes affecting diesel engine usage for passenger cars and trucks.

Most of my career (I am 64 years of age) has been associated with auto-related companies. I have the privilege of serving as a senior vice president of Colin, Hochstin Company, a member firm of the New York Stock Exchange. We are an investment banker and a securities broker/dealer specialized in institutional securities brokerage and research.

Besides serving as a supervisory analyst of research for Colin, Hochstin Company, I have headed our own financial research firm for the last eight years. This firm, with associates, provides counseling and consulting services to business, industry and government: typically to American Telephone & Telegraph Company (as in training and counseling AT&T personnel in how to apply most advanced communication equipment); to Peat, Marwick, Mitchell & Co. (aiding this transnational accounting services firm in its services to auto-related companies and writing for it.

Other typical consulting services, lending experience of others to the diesel engine and related issues, are providing advisory services to leasing groups, consumer banking groups, lending groups, auto and truck dealer groups. Governmental services have included assistance with determination of cost effectiveness of regulatory matters, inter-relationships of primary vehicle producers and their suppliers, and for the Financial Analysts Federation studies on vehicular material usage and changes in materials and specifications. A very current project is to advise auto dealers in coping with a 13-quarter recession/depression in new domestic car sales.

My education and background have been in the arts and sciences, in engineering (for Sperry Gyroscope Company's Engineering Division), finance (within the auto industry and Wall Street), and -- as an unpaid appointee for 11 years -- in the management and administration

Arvid Jouppi Materials on Newly Emerging Diesel Technologies in Preparation for Giving Testimony in Washington, D.C., Thursday, May 6, 1982, before Subcommittee on Investigations and Oversight.

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of monies of a major church body headquartered in St. Louis. My research scope has had to be worldwide since 1963, when it first became apparent that selected United States vehicle producers would grow worldwide.

In preparation for this testimony I have had good opportunity to meet with fleet owners, manufacturers of cars and trucks, and, to a limited degree, to gather a concensus from Wall Street financial analysts -- which is my own community. Let me especially commend the auto-related analysts of Mercantile Trust Company, St. Louis Union Trust Company and General American Life Insurance Company. We believe it would be useful to gather fresh viewpoints and data from other investment research analysts whose concern is, in major part, with the capital investment planning and cash flow matters of auto-related companies. My own oral testimony will touch upon this point, and we have been invited by the staff of this subcommittee to deliver written appraisals from key financial analysts whose organizations would permit them to prepare summaries, each his or her own, based upon personal research similar to our own. We will deliver these exhibits intact as they are received over the next few weeks, beginning about May 17.

It is an honor for me to appear today in my own position as an auto, machinery and parts financial analysts, student of the world auto scene since 1952.

Points to Discuss:

. . .Diesel fuel availability from the "standard barrel of crude" -- comfortably 35%, and above 50% a point of no return.

. . .Gasoline prices above $1.50 per gallon at today's dollar value invites dieselization of part of the passenger car market. Prices below this tend to favor gasoline. As a separate issue, we urge alternate fuel sourcing to insure a lasting supply of vehicular energy, come what may. Also we urge continued research into fission power as a 21st century energy source processable into vehiclular fuels. For the next SCORE of years, however, we need to rely upon gasoline and diesel fuels.

. . .Integrating all factors best we can, we look for only 20% of the passenger car fleet to be dieselized in the production of 1990 cars. We believe manufacturers should not depend upon quick return of gasoline prices to the $1.50 per gallon which can be met -- but requiring appropriate utilization of our immense scientific and technologic resources -- growing now out of our vast educational and laboratory complex. Future generations, now at video games, assure our nation continued growth and advancement in meeting technological standards needed for our national well-being: and to preserve our industrial leadership role worldwide.

Arvid F. Jouppi

area, but regard a rise as a certainty: both to cover costs of crude, refining and distribution costs and to allow for an almost certain need for higher fluid taxes in order to pay for expansion and modernization of our current $800 billion national highway and road system.

. . .Fuel cost and availability must be predicted in order to determine proper national policy regarding particulates. It is our view that the higher prices will bring on more diesel-engined passenger cars and the necessity for balancing the national welfare: clean air versus ability of the nation to operate with efficiency and economy for the food-clothing-shelter-communication needs of our people.

. . .Group 6, 7 and 8 trucks and off-highway vehicles need less rigid standards in order to function efficiently. We do not now have a recommendation on what the standard should be -- but nearer to 0.7 gpm than 0.35, which we would suggest as a passenger car standard. (Generally, while we do not always agree with the manufacturers that a technical advance can not be made, we do feel that by 1985 the standard should be 0.35 gpm, and not seek an 0.2 gpm particulate standard at this time.

. . .For larger engines, it is our view that the cleanup should be part of the engine itself, and for smaller vehicles add-on devices will, from the physics and physical viewpoints, be needed. Substantial particulate removal and automatic burning technology needs to be done even now, to meet an 0.35 gpm standard.

. . .To the best of our knowledge, there is not any European or Japanese mass-produceable device which would do what is needed. Rather, the United States has the opportunity to be the world standard setter -- and, by persuasive means -- seek adoption of the United States standards as the world standards.

. . .We have been unable to arrive at a position regarding the health and visibility standards.

. . .We believe the United States auto industry should establish world standards for clean air and that the United States Government has the responsibility to set reasonable standards

Mr. **Gore**. Thank you very much. Incidentally, I forgot at the outset to ask unanimous consent that the opening statement of my colleague, Mr. Walker, be included immediately after mine at the beginning of the hearing, and I would invite my colleague, Mr. Volkmer——

Mr. **Volkmer**. I do not have an opening statement.

Mr. **Gore**. Welcome, Dr. Doniger. Without objection, the entire text of your statement will be put into the record.

Mr. **Doniger**. I thank the committee for the invitation to testify here.

Natural Resources Defense Council, as you know, is a national citizens organization, with more than 30,000 members in the United States, dedicated to protection of public health and the natural environment. Unless good pollution controls are installed on the diesel, there threatens to be a serious increase in respiratory disease, including lung cancer, and a substantial decline in the quality of the urban environment, primarily from a loss of visibility.

The EPA established a particulate matter standard for the 1985 diesel cars, and is considering one for diesel trucks, although without any demonstrated aggressiveness. We believe the technology has been coming along faster than was projected, that it will be there in time to meet the 0.2 gram standard for 1985 on the diesel cars, and that is both needed and feasible and at a reasonable cost. Despite these advances, EPA is moving towards relaxing the standard for diesels autos. It seems to us that if we are not vigilant and unless EPA changes its course, particulates may join carbon monoxide and lead in being swept under the rug—another health problem not being dealt with by EPA.

The automakers have asked EPA to weaken the standard, to eliminate it. I know this hearing is principally about the technology, but I would like to review the risk to health and the natural environment from diesel particulate. We believe the diesel engine offers the Nation a promise and a threat. There are significant energy savings to be derived from the diesel, but the growing volume of particulate emissions also poses a serious threat to public health.

I have quoted in my testimony and appended to the back of it a letter from eight respected prominent scientists in the fields of respiratory health and visibiity. This is a letter to Anne Gorsuch, dated December 3, 1981, in which they summarized their view of the potential health risk, and can be found on pages 3 to 6 of my testimony.

The principal problem is that the diesel particulate is very "fine," which is a term of art reserved for particles that are less than about 2½ microns, or 1 ten-thousandth of an inch, across. These can be inhaled and lodged deep in the lung. Some of the estimates of how much that is inhaled can be retained in the lung approach 50 percent. The lung's mechanisms for clearing this matter are most ineffective for particles in this size range. The particles' composition is worrisome. They are composed of carbon at the core, but on the surface there are up to 10,000 different chemicals, many of which are known or suspected carcinogens or mutagens.

Proving that these chemicals, delivered like multiple independent reentry vehicles to the depths of your lungs, are going to cause cancer is a difficult problem. But because it is so difficult we should consider very carefully what kind of proof is needed in order to justify reasonable control measures as a preventive measure. The doing of a proper epidemiological study on what would happen to people exposed to this particulate matter would take many years. The only study which has been done is of London bus workers, and in the hearings held a couple of years ago before this subcommittee on this subject, the General Motors witnesses agreed that that study is, in the terms of the trade, very insensitive. It is not capable of finding anything but a very big risk. Moderate-to-small-sized risks that would translate into hundreds or thousands of deaths per year would escape notice in that kind of study. So the London study does not prove anything about the safety of particulates, except that the death rate from diesel particulates may be less than the 8,000 mark per year. It is not a helpful study in showing that the stuff is safe.

The best thing we have to go on is knowledge of what the particles are composed of, how they get into the lung, and what the chemicals can do. There is no reason to think that combined together they are safer. We have a serious health risk here of cancer and associated other diseases like aggravation of asthma, bronchitis, and emphysema.

Neither these scientists nor anyone else can yet know with certainty the magnitude of the danger to public health that could come from increased exposure to diesel particulate emissions. Plausible estimates of the number of excess lung cancer cases to expect each year if diesels are not prudently controlled suggest that diesels' health effects may well be significant. Such risk estimates range from less than 30 excess lung cancer cases to an upper bound of approximately 8,000.

It seems to us that given that range, given the number of people that are at risk at the high end of the range, we are talking about a significant health problem. We ought to do all we reasonably can to prevent it before we take the human experiment.

Now, let me turn to a few comments about the technology. Let me first say about the market penetration of diesels, it seems that everybody agrees that if the auto industry were on its proper level of sales or its historical rate of sales, diesels would be coming on quickly, and would approach 20, 25 percent of sales in 1980. The estimates that I have seen that bring that number down are dependent on the total industry being in a slump. But it seems to me unimportant whether we are talking 15 percent or 20 or 25 percent of the new car sales in 1990 as being diesels. The idea should be to nip the auto diesel problem in the bud, and to reduce emissions also from trucks, although there the problem is no longer in the bud, since there are lots of diesel trucks around. Nipping the problem as early as we can is important both from a point of view of the visibility problem in the cities and with respect to the health problem.

The automakers have historically been very, very pessimistic and underestimating of their capabilities to invent technology to solve auto pollution problems. I would just like to bring to mind the record in the 1970's, what happened with respect to catalytic converters. In 1973, under the 1970 Clean Air Act, the automakers were entitled to ask EPA for a waiver of the deadline for meeting the original auto standards, the ones that have since been met, although in 1981. The principal issue there was could they or could they not use a catalytic converter. In these March 1973 hearings General Motors predicted a catastrophe would occur if they were forced to use catalysts on their cars. They said:

> [I]f GM is forced to introduce catalytic converter systems across-the-board on 1975 models, the prospect of an unreasonable risk of business catastrophe and massive difficulties with these vehicles in the hands of the public must be faced.

GM Response: The implication of Mr. Doniger's statement is that General Mortors has "cried wolf" previously in our assessment of the status of major advances in emission control technology, and therefore our assessment of the status of particular trap technology should not be believed. Mr. Doniger's reference to a portion of our testimony, taken out of context, and his misinterpretation of our statement have greatly distorted the position expressed by General Motors in the March 12, 1973 hearings on suspension of the 1975 light duty vehicle emission standards.

General Motors did not "predict a catastrophe would occur," only that it was a possibility that should be considered. Mr. Doniger's interpretation that we predicted catastrophe is not supported by the record of that hearing. Mr. Doniger has quoted only a portion of the complete sentence from our testimony, which reads:

"*The result is that, if* GM is forced to introduce catalytic converter systems across-the-board on 1975 models, the prospect of an unreasonable risk of business catastrophe and massive difficulties with these vehicles in the hands of the public must be faced." (emphasis added)

By omitting the first part of the sentence, Mr. Doniger implies that the GM quotation contained in his statement was intended to stand alone, when in fact the concern expressed was in reference to a previous, qualifying discussion.

This discussion in the original GM testimony indicated that, in spite of committing very large sums of money to two catalyst programs to preserve a thin lead-time margin for both, we had not developed assurance that any catalyst system could meet the 1975 emission standards on all of our 1975 models. Further, not enough time remained to adequately test catalytic converter systems in the field, in the infinite variety of consumer use patterns.

In view of this lack of field data, plus some unexplained failures of the most promising catalyst formulations, it was only reasonable to remind the Congress that catastrophic problems could occur. To minimize this unquantifiable risk, we recommended that standards requiring catalysts be applicable only in California for the 1975 model year. This would give General Motors a better chance to find any unexpected problems that could arise in use.

By quoting only a portion of the original sentence, out of context, Mr. Doniger has greatly misrepresented the concern expressed in our 1973 testimony. The full context of the statement, from pages 7–8 of General Motors March 12, 1973 testimony before EPA follows (emphasis added):

"The second matter which the Administrator must consider is the state of development with respect to catalytic converter systems. As pointed out previously, in the durability testing of cars with catalytic converter systems, our successes and failures have been almost evenly balanced. Furthermore, *we have had no significant opportunity to test these cars under real life use conditions.*

"Furthermore, there has been and will be *no time for adequate testing of the extensive tooling required* for these projected 1975 systems. A number of important components will be built on brand new, highly complicated, and untried tooling. Moreover, certification testing should begin in November of this year.

"The result is that, if GF is forced to introduce catalytic converter systems across-the-board on the 1975 models, the prospect of an unreasonable risk of business catastrophe and massive difficulties with these vehicles in the hands of the public must be faced.

"It is conceivable that complete stoppage of the entire GM production could occur, with the obvious tremendous loss to the company, shareholders, employes, suppliers and communities. Short of that ultimate risk, there is a distinct possibility, of varying degrees of interruption, with sizable dislocations. Consequently, GM believes that, if stringent emission control systems are to be required for 1975 cars, in our case meaning catalysts, their application should be limited to the State of California. This represents an estimated 7 percent of GM's 1975 production, which would

> be in line with our usual practice of initially introducing new features on a limited number of new models. Thus, even though the solving of problems in this proposed situation would be costly, it would not be catastrophic."

Mr. DONIGER. EPA granted the postponement in April 1973. But within a month GM reversed its public stand and proclaimed that catalysts were the "best choice." In 1975 GM put catalytic converters on its entire nationwide production after all.

A 1975 report of the National Academy of Sciences prepared amid demands for further delay has a very instructive conclusion. It said:

> There has been an apparent reluctance on the part of the manufacturers actually to assemble in a demonstration vehicle the component emission control technologies which the manufacturers have in hand. In this way they can maintain with some consistency that the technology "has not been demonstrated."

We believe the history of exaggeration and reluctance has to be kept in mine when this committee reviews the claims of the manufacturers about impossibility, which you will inevitably hear. The pace of technology is not something that is out of the automakers' control. It is something which they have rather direct control over.

The automakers claim that since the issuance of the Federal standards there has not been the necessary progress. This is simply not so. The control developments that are needed come anywhere in the system from the engine to the end of the tailpipe, and there have been advances on all those fronts.

In terms of what are called "engine out" emissions, the emissions that come from the engine itself, EPA projected in 1980 that the companies by 1985 would have to get the "engine out" emissions down to 0.5 grams per mile. In fact the 1982 and 1983 certification vehicles for even the worst models are beating this target. Also we have read in trade press that GM does not plan, for example, to have its current worst performer, the 350-cubic-inch engine, in service in the mid- and late eighties. They will have replaced it with a new engine that yet is more advanced and cleaner.

The progress in reducing "engine out" emissions also reduces what the trap-oxidizer has to do. When you reduce the percentage removal that the trap has to accomplish, you make it easier to build one that will last a longer time. The keystone of the manufacturers' argument that this cannot be done is that it has not been done. Except that is not true, it has been done. The automakers are going to have a lot of trouble, I think, explaining away the successful test results of the Johnson-Matthey Co., which has run a trap-oxidizer for 50,000 miles in a test in Texas through the fall of last year, concluded in December. They had no trouble running the car successfully with a trap-oxidizer that regenerated and worked at approximately the same level of control all the way through, well enough at the beginning and the end to meet the standards with a hefty margin to spare. By their own representations the company can produce this trap oxidizer in mass quantities in 12 to 18 months of getting orders for it. Yet they are not getting orders for it.

According to the record of the EPA reconsideration that is going on now, there are 82 cars between 20,000 and 60,000 miles that have been or are currently being run with various manufacturers' trap designs, and yet I believe the testimony of General Motors will be that the best they could do is 1,300 miles.

I think it would be very interesting for this committee to ask the companies for the details on these more advanced tests, some of which they have refused to give EPA or refused to give the public, because they contend these details are secret.

We think there is plenty of leadtime left. In a recent petition to EPA to suspend the standards, GM has added significant new fudge factors that it never mentioned before. Its timetable has a lot of fat in it. I will not go through the details, except for one in particular GM claims that certification of compliance with emission standards "can" take 18 months. Certification is the step of showing that a demonstration of a prototype vehicle will meet the standards. In reality, certification can be and often is completed more rapidly, in 6 months or less. The time it takes is within the manufacturer's control. They can run the tests at the pace they choose. So it is not true that GM needs as much leadtime as it says it needs in order to meet these standards.

By comparison, GM's director of engineering for Chevrolet says that the company is now capable of designing a whole new engine from scratch to mass production in 2 years, and this includes the time needed for certification of compliance with all emission requirements.

The cost issue is very important. The automakers' complaints about potential costs are highly exaggerated. From time to time General Motors has suggested that very high cost figures are in order. Two years ago, GM told EPA essentially this. They said "we do not know how to do it, but if we did it would cost $600." And in today's testimony they say again, "we do not know how to do it, but if we did, it would probably cost $500."

Recently in an editorial in the Wall Street Journal which appears to have been based on substantial discussions with General Motors, a figure of $1,200 was cited from General Motors, again without details or substantiation. It seems to us odd to tell you what a control device will cost at the same time you maintain you do not know how to build one.

According to the Johnson-Matthey Co., the active components of the trap oxidizer can be sold in quantity for about $100 per car or less, and generously allowing an equal amount for associated equipment, the cost of these controls would still be only a couple percent of the cost of the cars. That is less than the cost of the controls on gasoline engines.

This effort does not pose any significant problem for the auto industry. In 1980 the Office of Management and Budget found that removing all air and water pollution control requirements on the industry, for both vehicles and the factories in which they are made, would lower the industry's capital requirements in the eighties by only 3.5 percent. We are talking here about one regulation, which if removed would save them much less money. The National Commission on Air Quality has a similar conclusion.

We think diesels already have a regulatory subsidy, even though they emit pollution which may well be more dangerous than that from gasoline cars. Even with trap-oxidizers, the cost of diesel emission control would be significantly less than the cost of controls for their gasoline counterparts, and there is no grounds for the automakers to complain here.

One issue that has come up is the problem of simultaneously controlling both particulate matter and oxides of nitrogen to the required levels for 1985. Again, there have been advances in pollution control technology which should make this no problem. Principally what it amounts to is putting the exhaust gas recirculation system under electronic control, as most of the rest of the emission control systems of these cars already are or will be. If you modulate the exhaust gas recirculation through computer control, you can reduce the tradeoff that they are experiencing now to the point where it will not be a problem to meet 0.2 gram particles and 1 gram NOX at the same time.

Let me say a couple of words about the National Academy of Sciences diesel study. The automakers rely heavily on its conclusions, but this report was 18 months out of date when published, and its analysis contains serious gaps and shortcomings.

First, as admitted in the report's own preface, the Academy panel stopped gathering information in August of 1980, and that is just 6 months after EPA promulgated its standards.

Its technological conclusions are simply stale. A new volume came out I believe last week or 2 weeks ago called "Diesel Technology," and a quick look at the bibliography discloses not a single reference later than 1980. They stopped work on this in August 1980 or before.

The panel suggests that the automakers need more leadtime than any of the automakers themselves have said they need. Without presenting any support in any volume of the Academy report, the panel opined that 5 years would be needed from the time of demonstrating a trap oxidizer to commercially introducing it. In the whole EPA rulemaking, the most time that any of the automakers said they needed for this step was 3 years, and some said they needed as little as 18 months. General Motors now says it can design and produce a whole new engine in 2 years, including compliance with all regulatory steps.

Even assuming there was a legitimacy to the kind of cost-benefit analysis which the panel did, its grand analysis has a number of serious flaws. Two of the most serious are its principal reliance on extreme cases and its wooden analysis of the safety issue.

The Academy panel specifically eschewed making any judgment about the likely number of deaths to occur from diesel particulate matter. Instead, they assumed in the extreme that you would have either zero or the loss of 46,000 "person-years" by 1995. It is not possible from the report itself to see how many deaths that represents per year. I am sure that could be worked out, but I do not have that available. The consensus, we believe, of most independent scientific experts would be that the "zero option" would be so unlikely that it should not be the basis of such an analysis. The panel also assumed the extremely unlikely case of zero impact on visibility as one of its extreme cases. This too is so unlikely it should not be the basis for the analysis.

Second, the panel assumed that vehicle weight is, and by implication should be the principle mechanism for achieving auto safety. The panel assumed that fewer diesels necessarily means more dangerous vehicles. The panel neglected the wide range of design modification—many that are quite inexpensive—which could be adopted to improve the safety of autos at the same time their weight and size are reduced.

The panel also ignored some important distributive problems—the possibility that my buying a heavy diesel may make me safer, but at the risk of greater danger to somebody that drives a smaller car that I happen to run into.

In conclusion, we urge EPA, and we would urge Congress too, to stick with the 1985 particulate matter standard at least for another 18 months to see whether the automakers,when push comes to shove without an easy out, can do it. In 18 months you will still have time to change course if that is necessary, but right now the automakers are looking for a quick, easy way out, and they are coming forward with claims that they cannot do it in order to justify this. But they have not made the effort yet, and they have not revealed all the efforts that they have made, and it looks like the only evidence that is on the table goes against them.

We also want to reiterate the pressing need for standards for particulate from diesel trucks and buses. EPA is finally going to hold a hearing in July to move this proposal along. We will participate in that, and we hope very much that the Agency gets that standard out. It was due out in 1981 by law. It is now 1982. It is projected in the proposal that it would apply in 1986 at the earliest. Even the National Academy report says that truck standards are badly needed, and we hope that EPA will rapidly move on to that.

Thank you.

[The prepared statement of David Doniger follows:]

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Testimony of

David D. Doniger

on behalf of

Natural Resources Defense Council

on

Emission Standards
for Diesel-Powered Vehicles

presented before the

Subcommittee on Investigations and Oversight
of the
House Committee on Science and Technology

May 6, 1982

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Good morning Mr. Chairman and members of the Committee. The Natural Resources Defense Council is grateful for the invitation to present its views before this Committee on the urgent need to reduce the fine particulate matter emissions from the growing fleet of diesel automobiles and trucks.

NRDC is a national citizens organization, with more than 30,000 members in the United States, dedicated to protection of public health and the natural environment. Unless good pollution controls are installed on the diesel, there threatens to be a serious increase in respiratory disease, including lung cancer, and a substantial decline in the quality of the urban environment.

The federal Environmental Protection Agency has established a particulate matter standard for 1985 model autos and light trucks. This standard would reduce diesel car particulate emissions to 0.2 grams per mile (g/mi) and diesel light truck emissions to 0.26 g/mi. We believe this standard, in conjunction with the 1.0 g/mi standard for oxides of nitrogen, represents the bare minimum of responsible control of this pollutant for 1985, and that standards should be more protective still for later years.

Effective control technology has been fast in developing. It has developed more rapidly, in fact, than anyone predicted. It will be available by the 1985 model year.

Despite these advances, the federal EPA is now entertaining the special pleading of the auto makers for postponement or weakening of this standard. The auto makers have asked EPA to ignore its past concern for the health and environmental hazards of this pollutant, and to abandon its duty to set technology-advancing standards. EPA has already made a significant concession to the auto makers by proposing a switch to an "averaging" approach. Though EPA has said nothing officially yet on the auto makers' basic demand, reports in the trade press warn of a delay in the 0.2 g/mi standard to 1987, or a worse relaxation of the standard. There is ample reason to fear that the Agency's current management is all too predisposed towards the auto makers' viewpoint.

EPA has also failed to set the particulate matter standard for heavy-duty diesel vehicles mandated by the Clean Air Act. These vehicles are rapidly on the increase too. A standard was proposed in 1980, but under EPA's new management it has not budged an inch. Recently, EPA announced it would hold the long overdue public hearing on these standards in July. This is a welcome sign, but the trade press contains warnings of watering down this proposal too.

I. The Urgent Health and Environmental Need For Diesel Particulate Control

The diesel engine offers the nation a promise and a threat. On the one hand, it yields significant energy savings. But the growing volume of particulate emissions also poses a potentially very serious threat to public health.

The health risks from diesel particulate matter were well summarized in a letter from eight respected scientists to EPA Administrator Anne Gorsuch on December 3, 1981. They said:

> "Potential Risks To Public Health
>
> "Uncontrolled diesel engines emit 30-70 times more particulate matter than conventional gasoline engines. This particulate matter has been a matter of medical concern for a number of years. The principal reasons why may be summarized as follows:
>
> "o 97 percent of diesel particulate matter is in the small size range -- so-called "fine particles" -- that are generally agreed to pose the greatest danger for human health. Particles in this size range (less than 2.5 microns or about 1/10,000th of an inch in diameter) can be inhaled and lodged deep in the lungs, in the region of the most sensitive lung tissue. The lungs' mechanisms for clearing foreign matter are least effective at removing particles in this size range.
>
> "o The particles are generally composed of carbon at the core. However, it is estimated that up to 10,000 different chemicals may be adsorbed on such particles. They can be carried deep into the lungs. Research has demonstrated that these chemicals can come off the particles in the lungs, and can come into contact with potentially sensitive cells in the lungs, blood stream, and other organs of the body.

"o A number of the chemicals adsorbed on diesel particles are known to be capable of causing cancer in laboratory animals and are suspected of causing cancer in humans.

"o Chemicals extracted from the particles also have been shown to be mutagenic in a wide variety of short-term bioassays. Chemicals which are mutagenic in such tests have a high probability of being carcinogenic in animals or humans.

"o In addition, there is substantial evidence that particles in this small size range can contribute to or aggravate chronic obstructive lung diseases, such as asthma, bronchitis, or emphysema.

"No one can yet know with certainty the magnitude of danger to the public health that could come from increased exposure to diesel particulate emissions. Plausible estimates of the number of excess lung cancer cases to expect each year if diesel emissions are not prudently controlled suggest that diesels' health effects may well be significant. Such risk estimates range from less than 30 excess lung cancers [Cuddihy (1981)] to an upper bound of approximately 8000 [Thorslund (1981), from J. Harris (1981)]."[1]

---

[1] Boushey, et al., Letter to Anne M. Gorsuch, Administrator, U.S. Environmental Protection Agency (Dec. 3, 1981), pp.1-2. (Attached as Appendix A). The authors of the letter were:

Homer A. Boushey, M.D.
Assistant Professor of Medicine, and
Associate Staff Member, Cardiovascular Research Unit
University of California
San Francisco, California

Stuart M. Brooks, M.D.
Head, Clinical Studies Division, and
Associate Professor of Medicine & Environmental Health
University of Cincinnati College of Medicine
Cincinnati, Ohio

Douglas Hammer, M.D.
Director, Emergency Room
Rex Hospital
Raleigh, North Carolina

Robert Harris, Ph.D.
Senior Engineering Advisor, Clement Associates Washington, D.C., and
Consultant, Center for Energy and Environmental Studies, Princeton University
Princeton, New Jersey

(footnote continued)

Moreover, the diesel fleet is growing rapidly. In the mid 1970's, diesels made up less than one half of one percent of the auto fleet. They now amount to about 10 percent of new car

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(footnote continued)

Robert J. Mason, M.D.
Head, Pulmonary Division,
National Jewish Hospital, and
Professor of Medicine,
University of Colorado
Denver, Colorado

Jonathan Samet, M.D.
Assistant Professor of Medicine
University of New Mexico School
of Medicine
Albuquerque, New Mexico

John Spengler, Ph.D.
Assistant Professor of
Environmental Health
Harvard School of Public Health
Cambridge, Massachusetts

Alan P. Waggoner, Ph.D.
Associate Professor
Department of Civil Engineering
University of Washington
Seattle, Washington

Since the letter was sent, a number of other prominent scientists have indicated their agreement with it, including:

Dr. Arthur C. Upton
Professor and Chairman
Institute of Medicine
New York University Medical
Center
New York, New York
(Dr. Upton is a former Director
of the National Cancer
Institute)

Dr. Norton Nelson
Professor
Institute of Medicine
New York University Medical
Center
New York, New York

The references in the letter are to:

Cuddihy, et al., Potential Health and Environmental Effects of Diesel Light Duty Vehicles (Oct. 1980).

J. Harris, Potential Risk of Lung Cancer from Diesel Engine Emissions (report to the Diesel Impact Study Committee, NRC, 1981).

The paper by Thorslund is an assessment of projected population exposures to diesel particulate emissions, from 1981. We do not now have the exact title. Thorslund is a scientist with the Environmental Protection Agency.

sales and are projected to reach as high as 25 percent by 1990. If not controlled, this particulate matter may cause thousands of cases of lung cancer and other serious respiratory diseases such as emphysema each year.[2]

Even more surely, poorly controlled diesel particulate emissions will drastically cut visibility in urban areas. If diesel emissions increase without effective controls, how far one can see may be reduced by 20 percent in Los Angeles.[3] It may be diminished by a third in typical eastern cities, and by more than half in typical western cities which still have clean air.[4]

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[2] The scientific findings on the health risks of diesel particulate are further summarized and referenced in the testimony of David Doniger and A. Karim Ahmed, before the Subcommittee on Natural Resources and Environment of the House Committee on Science and Technology (Oct. 1980), attached as Appendix B.

Also see generally the report of the Health Effects Panel of the National Academy of Sciences' Diesel Impact Study Committee (Oct. 1980).

On the health and environmental hazards of fine particles, see generally, F. Perera & A.K. Ahmed, Respirable Particles: Impact on Health and Environment (1979), attached as Appendix C.

[3] National Commission on Air Quality, To Breathe Clean Air, p.217. We understand that additional evidence on diesels' serious degradation of visibility in California is being presented at this conference by Dr. John Trijonis.

[4] National Academy of Sciences, Controlling Airborne Particles, p.59 (1980). See also the letter from Boushey, et al.

In light of this evidence and these serious health and environmental concerns, the scientists who signed the December 3 letter to Administrator Gorsuch concluded:

> "It is for these reasons that in light of the information available to date on diesel particulate emissions, we believe it would be unwise to terminate the Federal research program at this time, and imprudent not to make use of effective emission control technology which can be made available at reasonable cost."[5]

We commend their views to the Administrator, and to Congress.

II. The Advanced Status of Diesel Pollution Control Development

The auto makers are seriously understating the advanced status of diesel control technology development. The companies distort both the facts in the 1980 record and the facts since then. They continues to misrepresent the diesel pollution control problem as one requiring serendipitous scientific discovery beyond the companies' control, rather than just the application of their ample resources to a straightforward engineering task.

A. The Relevant History of Auto Pollution Control

The auto makers' position is really an attack on the basic commitment, embodied in both the federal Clean Air Act and the laws of California, to hasten the development and introduction of auto pollution controls beyond the leisurely pace the auto makers have set for themselves. The current controversy over diesel particulate -- the fastest growing and potentially most dangerous form of vehicular pollution -- is simply the latest episode in the industry's two-decade struggle against pollution controls.

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[5] Boushey, et al., p.3.

Automobile pollution is a classic example of market failure requiring government intervention. Without the stimulus of regulation, the auto makers will not take significant steps on their own. Market forces alone provide them no economic incentives to install pollution controls. Indeed, market forces actually encourage auto companies to downplay their capabilities, especially as to future models. Because of its highly concentrated and integrated structure, the industry has considerable leverage to control the resources devoted to developing pollution controls, and to manage the flow of data to the government and the public.

To rectify the auto maker's failure to solve the pollution problem on their own, Congress established strong emission control legislation. Central to this legislation is the concept of technology-forcing, setting standards for future model years beyond the status quo of existing technology. This strong legislation reflects the determination that progress in auto pollution control would continue to be too slow if the pace of development were left solely in industry hands.[6]

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[6] For the record of the federal legislation, see S. Rep. No. 1196, 91st Cong., 2d Sess. 23-24 (1970) (1970 Senate Report);

(footnote continued)

The auto industry's negative economic incentives and its concentrated structure still pose problems, however. Because technological feasibility now is an issue in standard-setting, the industry has incentives to overstate technical difficulties. The auto makers have a clear history of so doing. It is a history the Members of this Committee should recall as they consider the EPA particulate standards.

The most striking example of exaggeration involved the development of the catalytic converter for gasoline engines 10 years ago. In March 1973, in proceedings to determine if EPA should postpone the statutory standards for 1975, the auto makers strenuously contended catalysts were not durable and should not be considered available for 1975. General Motors in particular predicted catastrophe unless the standards were changed.[7]

(footnote continued)

H.R. Rep. No. 1783, 91st Cong., 2d Sess. 48-49 (1970) (1970 Conference Report), reprinted in 1 A Legislative History of the Clean Air Amendments of 1970 at 423-24, 198-99 (1974). See also statements of Senator Muskie, chief architect of the Act, in the Senate debate, 1 Legislative History at 229.

[7]

> "[I]f GM is forced to introduce catalytic converter systems across-the-board on 1975 models, the prospect of an unreasonable risk of business catastrophe and massive difficulties with these vehicles in the hands of the public must be faced."

Statement of General Motors Corp., Transcript, Motor Vehicle Pollution Control Suspension Hearings, Mar. 12, 1973, at 29-30.

In April 1973 EPA granted the postponement.[8] But within a month, GM reversed its public stand and proclaimed catalysts the "best choice."[9] In 1975, GM installed catalysts on its entire nationwide production after all.

A 1975 report of the National Academy of Sciences, prepared amid demands for further delays, concluded:

> "There has been an apparent reluctance on the part of the manufacturers actually to assemble in a demonstration vehicle the component emission-control technologies which the manufacturers have in hand. In this way they can maintain with some consistency that the technology 'has not been demonstrated'. . . "[10]

This history of exaggeration and reluctance cannot be ignored when evaluating the claims of impossibility that CARB will inevitably hear.

B. The Auto Makers' Biased Portrait of the Status of Diesel Control Development

Though long on claims of impossibility, the auto makers' statements of position and testimony are short on factual specifics. They still attempt to convey the impression that the pace of development for trap-oxidizers is foreordained, unknown to the auto makers, and totally out of their control. But in fact, the development of these controls presents no new or novel scientific issues. As EPA stated when promulgating its standards:

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[8] 38 Fed. Reg. 10, 317 (1973).

[9] Letter from GM president Edwin Cole to Acting EPA Administrator Fri (May 9, 1973).

[10] National Academy of Sciences, Report of the Conference on Air Quality and Automobile Emissions (May 5, 1975), Supplementary Statement (July 29, 1975) at 6.

> "The improvements that are necessary are engineering problems, and are more a function of the resources allocated to the problem than any scientific or technical breakthrough."[11]

The necessary resources are well within the capabilities of the auto makers, with their tremendous engineering resources. Indeed, the controls are being developed principally by the much smaller companies which designed and supply to the auto makers the catalytic converter used on gasoline cars.

The auto makers claim that since the issuance of the federal standards two years ago, the passage of time has not produced the necessary answers. This is not so.

It must be emphasized that the control developments needed to meet the 1985 standards can come anywhere in the whole engine system, not just from a tail-pipe control. EPA projected improvements in engine design and engineering and in the trap-oxidizer, which together would be sufficient to meet the standards. These improvements are occuring on or ahead of schedule, and are producing even better results than EPA projected.

The first half of EPA's rationale for the standards was the projection that by the 1983 model year, the auto makers could bring the particulate emission levels of even the worst-performing models down to 0.5 g/m. In fact, the 1982 and 1983 certification vehicles for even the worst models are beating this target.[12] Moreover, publicly announced plans of the manufacturers show that very few, if any, of the worst-performing models will be marketed in 1985 and later model years. GM, for example, plans to replace its current 350 cubic inch engine with one of new design. It will be substantially cleaner than the current outmoded design.

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[11] 45 Fed. Reg. at 14,498.

The percentage reduction required from trap-oxidizers in order to reach the 0.2 g/m standard has thereby been lowered dramatically. With the necessary percentage reduction eased, the difficulty of producing durable trap-oxidizers has also been eased.

The certification results also show that many diesel models will be able to meet the 0.2 g/m standard without any aftertreatment device at all. This alone should show the groundlessness of GM's claim that 1985 standards could force all diesels off the market.

The second half of EPA's rationale, development of trap-oxidizers, is now entering the final stages on the schedule the Agency projected. Johnson-Matthey, one of the independent suppliers of emission control equipment, has successfully completed a 50,000 miles test. The particulate emissions were reduced consistently to levels well below the 1985 standards and no significant deterioration occurred with mileage. Moreover, in these tests the Johnson-Matthey device needs regeneration only once every 1,000 miles.[13] This contrasts sharply with some auto makers' statements that methods they have investigated require regeneration every 40-100 miles.

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[12] This is shown by EPA's own certification data.

According to representatives of the companies that manufacture emission controls, "there are 82 cars between 20,000 and 60,000 miles that have been or are currently being run with various manufacturers' trap designs."[14] We hope the Subcommittee will request this information of the auto makers.

3. Remaining Lead-Time

Despite the progress to date, the auto makers contend not enough lead-time remains. Their position depends on contrived, exaggerated estimates of the time required for steps between now and introduction of the 1985 models. In a recent petition to EPA, for example, GM has significantly expanded its prior estimates of needed lead-time, adding new "fudge-factors" never before mentioned.[15]

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[13] Johnson-Matthey, Inc., Final Report on 50,000 Mile Volkswagen Rabbit Durability Test, (Feb. 1982). In addition, Mercedes-Benz successfully completed a test of 54,000 kilometers (about 35,000 miles) with a ceramic trap-oxidizer. Letter from Patrick M. Raher, Hogan & Hartson (representing Mercedes-Benz), to Michael P. Walsh, Deputy Assistant Administrator, EPA (June 17, 1981).

[14] Memorandum from Maureen D. Smith, Attorney-Advisor, EPA, to the Record, "Record of January 27, 1982, Meeting with the Manufacturers of Emissions Controls Association (MECA) on Trap Oxidizers (March 15, 1982).

[15] General Motors, Petition for Suspension of the 1985 Model Year Light-Duty Diesel Particulate Matter Emission Standards (Sept. 30, 1981).

GM's timetable has considerable fat in it. For the first time, the company claims the need for an extraordinary early production run at least six months before the start of 1985 production. Curiously, GM never mentioned this before. GM offers no explanation of the principles of "good engineering practices" to which it appeals for authority, nor does the company explain what it hopes to learn with this early production run. By way of historical comparison, GM managed to introduce the catalytic converter on its entire 1975 fleet (not just a portion, as required here) without the need for such a run.

Next, GM claims certification "can" take 18 months. This is a serious exaggeration. Certification can be, and often is, completed much more rapidly, in 6 months or less. The time required for certification is almost entirely in each auto maker's own hands. Therefore it is not true that GM "must" begin certifying vehicles equipped with trap-oxidizers by mid 1982.[16]

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[16] To arrive at this mid 1982 estimate, GM has added the six month pre-production period and the 18 month certification period end-to-end. Certification need take no more than six months. Even if the pre-production run were necessary, it could take place during certification. Thus, GM has at least a year more than it claims before certification must begin.

Finally, appealing again to "good engineering practice," GM claims it should have ordered tooling for the trap-oxidizer by June 1981. This is another serious exaggeration. In fact, GM will likely buy the only complex new portion of the technology, not build it itself. Johnson-Matthey has stated it could produce and supply trap-oxidizers within 12-18 months of receiving orders.[17] On this schedule, GM still has until early-to-mid-1983 before it must commit to ordering the device. The remainder of the modifications needed to meet the standards are minor and easily prepared for in much shorter time.

It is worth comparing the highly conservative schedule GM represents in this petition with its much better record in reality. According to the Director of Engineering for Chevrolet, the company is now capable of designing a whole new engine, from scratch to mass production, in two years. This includes the time necessary for certification of compliance with all emission requirements.[18]

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[17] Johnson-Matthey, Inc., "Control of Particulate, Hydrocarbon, Carbon Monoxide and Nitrogen Oxide Emissions From Diesel Engines," Information submitted for the EPA study of diesel emission control (Oct. 1, 1981).

[18] Paul King, Dir. of Engineering, Chevrolet Motor Div., General Motors Corp., "Tomorrow's Product Engineering: Better, Faster," paper presented at the University of Michigan's 1981 Management Briefing Seminar, "The New U.S. Automotive Industry," Traverse City,. Michigan (July 28, 1981).

4. Fuel Economy

GM's petition also raised for the first time claims of a fuel economy penalty, which it says come from "virtually" any type of trap-oxidizer. But the petition contained no evidence to support this claim.

When EPA promulgated the standards, the Agency concluded that these controls would have no fuel penalty. In fact, the use of turbochargers would actually improve fuel economy as it helped control particulates.[19]

Johnson-Matthey has found that their control device increases fuel use by less than 1.5 fluid ounces every 1,000 miles. This is the amount of fuel needed to trigger regeneration.[20] Needless to say, it is a trivial amount.

5. Cost Factors

GM's complaints about costs are also exaggerated. The only burden the company is now bearing is the modest cost of the development program, as to which GM has presented no cost data. Much of the development cost, in fact, is being borne by independent suppliers of emission control. The cost for GM are doubtlessly far less than those devoted to many less important activities such as annual styling changes.

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[19] EPA, Regulatory Analysis: Light-Duty Diesel Particulate Regulations at 102 (1980).

[20] Johnson-Matthey Comments. As noted above, GM claims regeneration for "some methods" of particulate control is required every 40-100 miles. The Johnson-Matthey device requires regeneration only every 1,000 miles.

GM from time to time has suggested much higher cost figures, but without offering any substantiation. Two years ago GM told EPA essentially this: "We don't know how to do it, but if we did it would cost $600." A recent highly partisan editorial in the Wall Street Journal cited an even wilder GM figure of $1200, again without details or substantiation. These figures bear no relation to reality.

According to the Johnson-Matthey Company, the active components of the trap-oxidizer can be sold in quantity for about $100 per car or less. Generously allowing an equal amount for associated equipment, the cost of these controls would still be only about a couple of percent of the cost of these cars -- less than the cost of controls for gasoline cars.

This effort does not pose any significant economic problem for the auto industry. In 1980, the Office of Management and Budget found that removing all air and water pollution control requirements on the industry, for both vehicles and factories, would lower the industry's capital requirements over the mid-1980's by only 3.5 percent.[21]

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[21] Office of Management and Budget, Regulatory Expenditures of the Domestic Automobile Industry (May 1980).

The National Commission on Air Quality concluded:

> "[N]on-air-quality-related factors have been the primary cause of the domestic industry's current financial condition."[22]

GM's complaint that diesels already cost more than their gasoline counterparts ignores two very important points. First, the higher sales price is a reflection of diesels' fuel economy advantage. The current price difference is a premium that the auto makers are able to exact because customers expect to recoup it in lower fuel costs. Considering lifetime costs, diesels are at no current disadvantage.

Second, diesels already have a regulatory subsidy, even though they emit pollution which may well be more dangerous than that from gasoline cars. Even with trap-oxidizers, the cost of diesel emission control will be significantly less than the cost of controls for their gasoline counterparts.[23] There is no grounds for complaint here.[24]

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[22] National Commission on Air Quality, To Breathe Clean Air, Finding 194, p. 29 (1981).

[23] EPA, Regulatory Analysis at 122.

[24] In one boilerplate sentence GM's petition also claims unspecified "potential safety consideration." No evidence is offered of the nature of these problems or of the difficulties in solving them. In NRDC v. Costle, 655 F.2d ___ (D.C. Cir. 1981), the Court of Appeals already found adequate EPA's answer to the only vague and speculative safety issues any of the auto makers has ever raised in a remotely concrete way.

6. The Charge That Diesels Could Be Forced Off The Market

GM has made a fantastic charge that the 1985 standards could preclude the sale of diesels. This charge has no basis. As EPA has long noted at least some diesel models will not need trap-oxidizers at all. They will be able to meet the 0.2 g/mi standard with engine modifications alone.

Only the heavier diesels will require a trap-oxidizer. And as discussed above, since the engine modifications have proven more successful than anticipated in the heaviest, worst-performing model, the percentage reduction required of the trap-oxidizer for even the worst current models will be less than EPA projected.

Moreover, GM's announced plans for further down-sizing and for replacing the current, poorly engineered 350 cubic inch diesel engines with newer, smaller engines make it highly unlikely that vehicles as heavily emitting as current models will be sold in 1985.

There is simply no support for GM's extreme contentions. In fact, these standards could be significantly tighter without precluding any diesel models from the market.

7. The Issue of Simultaneous Compliance with the Particulate and Oxides of Nitrogen Standards

The auto makers are attempting to make a substantial problem out of meeting the 0.2 g/mi particulate matter standard and the 1.0 g/mi oxides of nitrogen (NO_x) standard simultaneously. But the rapid advances in particulate controls, coupled with advances in NO_x controls, eliminate this problem as a serious concern.

First, as mentioned above, the "engine-out" particulate emissions have been coming down faster and farther than anticipated. This will continue, especially when GM replaces the current 350 cubic inch engine which now brings up the rear. This progress means that a greater trade-off between particulates and NO_x could be tolerated, if necessary.

But second, advances in NO_x controls are occurring which will make this unnecessary. By using "modulated" exhaust gas recirculation (EGR), controlled by a computer system to operate more efficiently, it becomes easier to comply with both the 0.2 g/mi particulate standard and the 1.0 g/mi NO_x standard simultaneously.

In 1980, Mercedes-Benz committed itself to introducing such a system in its 1982 model California vehicles. Although the company renegged on this commitment for 1982, the technology will certainly be available, to all diesel makers, by 1985. An on-board computer will already be required on diesels for both fuel economy and particulate control reasons, and it will be no significant problem to add another program for EGR control.

III. The National Academy of Sciences Diesel Study

In opposing the EPA standard later today, the auto makers will no doubt refer to the report of the National Academy of Sciences released last December. But the report's conclusions regarding the light-duty diesel standard should be rejected. The report was 18 months out of date when published, and its analysis contains serious gaps and shortcomings.

First, as admitted in the report's own preface, the Academy panel stopped the gathering of information in August of 1980, just six months after the promulgation of the EPA standards. Its technological conclusions are simply stale.[25] The rapid development of the control technology passed the panel by.

The panel also casually suggested the auto makers need more lead time than any of the auto makers themselves have said they need. Without presenting any support in any volume of the Academy report, the panel opined that five years would be needed from the time of demonstrating a trap-oxidizer to its commercial introduction. In the whole EPA rulemaking, the most time any of the auto makers said they needed for this step was three years, and some said they needed as little as 18 months. As noted above, GM now says it can design and produce a whole new engine in two years, including compliance with all regulatory steps.

Second, assuming one even accepts the legitimacy of making decisions of this sort on the basis of formal cost-benefit analysis, the panel's grand analysis has a number of serious flaws. Two of the most serious are its principal reliance on extreme cases, and its wooden analysis of the safety issue.

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[25] The "Diesel Technology" volume, just published in April, is equally stale. A quick look at the bibliography discloses not a single reference more recent than 1980.

The Academy panel specifically eschewed making any judgment about the likely number of deaths to occur from diesel particulate matter. Instead, the panel assumed the extremes that the particulate matter would result in either zero deaths or in a loss of 46,000 "person-years" per year by 1995. With these assumptions, and others, the panel suggested that the cost of wrongly staying at 0.6 g/mi might be less than the cost of wrongly going to 0.2 g/mi.

We believe, however, that most independent scientific experts would find the "zero-option" so unlikely that it should not be the basis of such an analysis.

The Academy panel also assumed the extremely unlikely case of zero impact on visibility as one of its extreme cases. This too is so unlikely it should not be the basis for the analysis.

Second, the panel assumed that vehicle weight is (and, by implication, should be) the principal mechanism for achieving auto safety. The panel assumed that fewer diesels necessarily means more dangerous vehicles. The panel neglected the wide range of design modification -- many that are quite inexpensive -- which could be adopted to improve the safety of autos at the same time their size and weight is reduced.[26]

The panel also ignored some important distributive problems: the possibility that one person's driving a heavy diesel may make him safer, but at the cost of greater danger to anyone driving a smaller car involved in collision with him.

Conclusion

NRDC urges EPA to stick with the 1985 particulate matter standards, at least for another 18 months. This action is needed to serve the citizens of the U.S. by protecting them and their environment.

NRDC also wants to reiterate the pressing need for standards for particulate from diesel trucks and buses. These vehicles are growing steadily and are still few in number, but are responsible for a large fraction of the diesel particulate load.

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[26] See e.g., National Highway Traffic Safety Administration, Small Car Safety in the 1980's (Dec. 1980).

APPENDICES

APPENDIX A:	Letter to A. Gorsuch from 10 Doctors (Dated 12/3/81) and 2 Attainment letters from N. Nelson and A. Upton
APPENDIX B:	EPA Diesel Particulate Standards Hearings (10/1,2/80)
APPENDIX C:	Respirable Particles - Impact of Airborne Fine Particulates on Health and the Environment, by Frederica P. Perera and A. Karim Ahmed

APPENDIX A

December 3, 1981

Mrs. Anne M. Gorsuch
Administrator
Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Mrs. Gorsuch:

The purpose of this letter is to register our concerns as scientists over diesel particulate emissions and the potential for risk to public health and damage to the urban environment.

A major change in motor vehicle technology is now taking place in the United States. For the first time, the diesel engine is coming into widespread use. In the 1970s fewer than one car in 200 was powered by the diesel engine. It is now projected that by 1990, diesels may make up 20 to 25 percent of new car sales. In the '70s, one fourth the heavy trucks and buses were diesels. By 1990 that is projected to rise to at least two thirds of new truck and bus sales.

The rapid growth of the diesel offers the Nation significant fuel economy benefits. But its particulate matter emissions, unless prudently controlled, may pose a significant risk to public health. These emissions also could cause a substantial decline in visibility in the Nation's urban areas.

For the reasons explained below, we believe it would be unwise for EPA to terminate Federal support for research into the potential health and environmental effects of diesel emissions at this time. We also believe it would be imprudent to forego the use of such effective emission control technologies as can be made available at reasonable cost.

Potential Risks To Public Health

Uncontrolled diesel engines emit 30-70 times more particulate matter than conventional gasoline engines. This particulate matter has been a matter of medical concern for a number of years. The principal reasons why may be summarized as follows:

- 97 percent of diesel particulate matter is in the small size range -- so-called "fine particles" -- that are generally agreed to pose the greatest danger for human health. Particles in this size range (less than 2.5 microns or about 1/10,000th of an inch in diameter) can be inhaled and lodged deep in the lungs, in the region of the most sensitive lung tissue. The lungs' mechanisms for clearing foreign matter are least effective at removing particles in this size range.

- The particles are generally composed of carbon at the core. However, it is estimated that up to 10,000 different chemicals may be adsorbed on such particles. They can be carried deep into the lungs. Research has demonstrated that these chemicals can come off the particles in the lungs, and can come into contact with potentially sensitive cells in the lungs, blood stream, and other organs of the body.
- A number of the chemicals adsorbed on diesel particles are known to be capable of causing cancer in laboratory animals and are suspected of causing cancer in humans.
- Chemicals extracted from the particles also have been shown to be mutagenic in a wide variety of short-term bioassays. Chemicals which are mutagenic in such tests have a high probability of being carcinogenic in animals or humans.
- In addition, there is substantial evidence that particles in this small size range can contribute to or aggravate chronic obstructive lung diseases, such as asthma, bronchitis, or emphysema.

No one can yet know with certainty the magnitude of danger to the public health that could come from increased exposure to diesel particulate emissions. Plausible estimates of the number of excess lung cancer cases to expect each year if diesel emissions are not prudently controlled suggest that diesels' health effects may well be significant. Such risk estimates range from less than 30 excess lung cancers [Cuddihy (1981)] to an upper bound of approximately 8000 [Thorslund (1981)].

Resolving the differences between these estimates will require much additional study. Substantial knowledge has been gained in the last five years from the research sponsored by the Environmental Protection Agency, by other agencies of government here and abroad, and by private industry. But because of the extraordinary complexity of evaluating diesel particulate emissions' health risks, much more research is still needed.

Potential Damage To Urban Visibility

Diesel particulate emissions may also have a profound effect on visibility in the Nation's cities. In a report on Controlling Airborne Particles (1980), the National Academy of Sciences estimated that if diesels autos achieve a 25 percent market share, and if their particulate emissions are uncontrolled, visibility in typical eastern cities could be reduced by one third, and visibility in typical western cities could be reduced by more than one half.

* * *

It is for these reasons that in light of the information available to date on diesel particulate emissions, we believe it would be unwise to terminate the Federal research program at this time, and imprudent not to make use of effective emission control technology which can be made available at reasonable cost.

Sincerely yours,

Homer A. Boushey
Homer A. Boushey, M.D.
Assistant Professor of Medicine, and
Associate Staff Member,
Cardiovascular Research Unit
University of California
San Francisco, California

Stuart M. Brooks
Stuart M. Brooks, M.D.
Professor of Medicine and
Environmental Medicine, and
Head, Clinical Studies
Institute for Environmental Health
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December 11, 1981

The Honorable Ann M. Gorsuch
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Mrs. Gorsuch:

I have examined the statement prepared by a group of distinguished scientists (Dr. Boushey and others) for transmittal to you on the health implications of diesel exhaust. This statement, in my view, is accurate and sound. It has my complete support. The issue is a very important one for the health of this country, for industry, and for the economy.

I hope that the Environmental Protection Agency will accept the suggestions in the letter and move vigorously to resolve the current uncertainties noted in that statement.

Sincerely,

Norton Nelson

Norton Nelson
Professor

NN/j

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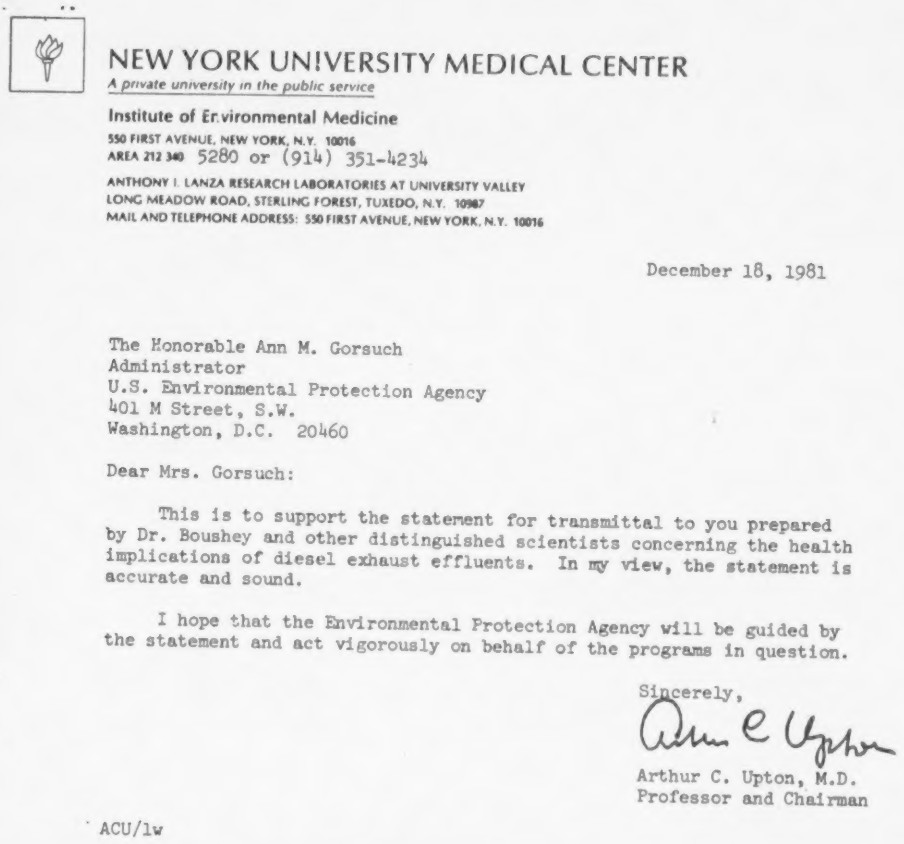

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December 18, 1981

The Honorable Ann M. Gorsuch
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Mrs. Gorsuch:

This is to support the statement for transmittal to you prepared by Dr. Boushey and other distinguished scientists concerning the health implications of diesel exhaust effluents. In my view, the statement is accurate and sound.

I hope that the Environmental Protection Agency will be guided by the statement and act vigorously on behalf of the programs in question.

Sincerely,

Arthur C. Upton, M.D.
Professor and Chairman

ACU/lw

Mr. **Gore**. Thank you very much.

Before calling on Mr. Walsh, I would like to recognize the ranking minority member, Mr. Walker, who has been the moving force behind the committee's examination of these issues and the effort to get a more sensible resolution of them.

Mr. **Walker**. Thank you, Mr. Chairman. I apologize for being late, and apologize for not being here to hear some of the opening remarks of the witnesses. I hope to get to some of my questions later on.

I appreciate the fact that you have seen fit to go ahead with these hearings. It follows up on hearings that were done about a year and a half ago, before the Environmental and Atmospheric Subcommittee of the full committee, and at that time I think we established some valuable material to put on the record. By following through with these hearings I think that we will additionally allow some important material to be put on the record with regard to diesels, and it is particularly important that we look at it at a time when Congress is going to be considering the Clean Air Act and other environmental measures in the weeks ahead. I certainly thank you for your willingness to see this subject through.

Mr. **Gore**. Well, thank you.

Mr. GORE. We will complete the first panel with Mr. Michael Walsh, a former director of the mobile source air pollution control section of EPA. Welcome, Mr. Walsh.

Mr. WALSH. Thank you, Mr. Chairman. I appreciate the opportunity to be here with you this morning. I am not appearing as a mere lawyer but as a mere engineer and private citizen.

The basic thrust of my testimony is that after an extensive process involving public hearing and full opportunity for comment from all interested parties, EPA adopted diesel particulate standards which to EPA at that time appeared necessary to protect public health and welfare. Since then I believe tremendous progress has been made in developing the technology to meet these standards. Health and welfare information continues to support the need for these standards.

Rather than reading my statement, as you suggested, Mr. Chairman, I will summarize parts of it in the interests of brevity.

In March 1980, EPA adopted the particulate standard for cars and light trucks. Beginning in 1982 model years, the standard was 0.6 gram per mile for cars and for light trucks. For 1985 models it dropped to a 0.2 gram-per-mile level for cars and 0.26 for light trucks. EPA adopted these standards because diesel fuel engines emit approximately 30 to 70 times the amount of particulate emitted by current-generation gasoline-powered cars that are equipped, incidentally, with catalytic converters. As diesel-fuel vehicles assume an increasing proportion of the light-duty-vehicle market, EPA estimated that their contribution to ambient total suspended particulate and fine particulate levels would also increase.

Many areas of the country are already unable to meet the national ambient air quality standard for total suspended particulate. EPA estimated that between 15 and 25 percent of all new light-duty vehicles and trucks sold by the late 1980's would be powered by diesel engines. The 0.2 gram-per-mile standard was based on a determination by EPA that some form of after treatment device would be available by 1985. EPA expected the trap oxidizers would be the preferred technology. The trap oxidizer is as its name implies a trap that collects the particles as they are passing out the exhaust, and then burns them up as they are accumulated. Assuming that market penetration for diesels rises to 15 to 25 percent, these standards were estimated to reduce particulate emissions from light-duty vehicles by about 74 percent in 1990 with respect to what would be expected without these regulations.

Beyond the significant TSP improvements that were expected from these regulations, EPA was also concerned about two special aspects of these particles, their small size and their composition. Small particles which are much more likely to be deposited in the deepest regions of the lung and which require much longer periods of time to be cleared from the respiratory tract have a greater potential to affect human health than larger particles. They also remain suspended in the air for longer periods of time, and therefore are more susceptible to being breathed by the general population. In control of diesel particulates, 100 percent is less than 15 micrometers in diameter, and approximately 97 percent is less than 2½, which is generally considered very fine particles. The chemical composition of diesel emissions as the extractable organic fraction of diesel particulate had been shown to be mutagenic prior to that adoption by EPA in various short-term bioassays.

What has been our experience since the rules were adopted 2 years ago? While we know that motor vehicle sales have plummeted, diesel car sales continue to climb. In 1981 diesel car sales climbed 32 percent over 1980 levels, and while projections for the future are subject to considerable uncertainty—and I will caveat that I predicted the Bullets were going to do a job on the Celtics—all of the projections that I am familiar with estimate that diesel sales will increase dramatically in the future over 1981 levels.

The recent estimates that I have seen project that anywhere from 13 to 14.6 percent of all passenger car sales in 1985, new cars, and from 18.8 to 25 percent in 1990 will be diesel. The estimates for 1990 could increase if real fuel prices, real energy prices, increase more than currently anticipated during the mid to late 1980's.

At the same time, the emission control industry and the auto companies have made tremendous strides, I believe, in the development of trap oxidizers. Collection efficiency has been improved, and operating systems have been developed that are compatible with the full range of driving modes.

Perhaps the most significant developments have been the recent dramatic successes alluded to earlier with the Johnson-Matthey system, but I know that work is going on as well with many other companies, as well as with the automobile companies themselves. Even without traps, the manufacturers have made very dramatic progress in reducing particulate emissions. A few vehicles have actually achieved a 0.2 gram-per-mile standard without traps, very small vehicles, I might add, but more significant is the fact that the larger vehicles and vehicles that perhaps may not even be on the road in the mideighties are generally down in the range of 0.3 to 0.4 at this time, very dramatic improvements.

With regard to the impact on public health and welfare, the recent report by the National Academy of Sciences indicates that we should continue to have grave concerns. The Academy notes:

> Because of their small size, (diesel particles) remain suspended in the air for a week or more and they can be inhaled and deposited in the narrowest passages of the lungs. Because of their small size, however, they offer a relatively large surface on which toxic, mutagenic, and carcinogenic compounds can be absorbed.

Dr. Wei testified just a couple of weeks ago before the State of California Air Resources Board, which is considering diesel particulate regulations, and he has also sent letters to the EPA Administrator raising other concerns, potential carcinogenic concerns with diesels.

Independent of the cancer risks, the NAS indicates other reasons for concern about diesel exhaust just as suspended particulate matter:

> Greater numbers of diesels in localities already experiencing photochemical smog may increase the conversion of gaseous sulfur oxides to sulfur containing aerosols. This possibility presents a health concern because high levels of SO2 and coexisting particulate pollutants have been associated repeatedly with increases in respiratory and mortality rates.

In addition to the direct health concerns, diesel particles can have a potential devastating effect on visibility. Again referring to the NAS report, which was reiterating a point made by EPA when it adopted its standards, it was noted that Denver could experience a 50-percent reduction in visibility when diesels comprise 25 percent of the total automobile fleet. In southern California, visibility impairment of about 20 percent would result. The Academy further noted that the severest loss in visibility from a large increase in diesel cars is likely to occur in street canyons of urban centers such as my home town, New York City.

Further, in recent comments to the EPA as part of its review of this standard, the Department of the Interior pointed out that:

> Western parks such as Grand Canyon, Zion, Bryce, Yosemite, and Canyonlands are being affected by the long range transport of urban plumes. A major component of these plumes is automobile emissions. Hence, any increase in emissions from diesel automobiles could have additional adverse effects on these parks.

That is the end of the quote.

I think I will terminate my statement at that point in time and leave the rest for the record, Mr. Chairman.

[The prepared statement of Michael Walsh follows:]

STATEMENT OF MICHAEL P. WALSH

Good morning Mr. Chairman and members of the Subcommittee. My name is Michael P. Walsh and I appreciate the opportunity to appear before you today. Prior to July 30th of last year, I was the Director of the United States Environmental Protection Agency's Office of Mobile Source Air Pollution Control, the office responsible for developing diesel particulate and other motor vehicle emission regulations. Presently, I am a private consultant and include the U.S. Senate Committee on Environment and Public Works, the United Nations Environment Program, the Manufacturers of Emissions Controls Association and Hamilton Test Systems among my clients. However, I am appearing before you today as a private citizen; none of my past or present clients have reviewed the testimony I am about to present to you.

The basic thrust of my testimony is that after an extensive process involving full opportunity for comment by all interested parties, EPA adopted diesel particulate standards which appeared necessary to protect public health and welfare. Since then, tremendous progress has been made in developing technology to meet these standards. Health and welfare information continues to support the need for the standards.

On March 5, 1980, EPA adopted particulate standards for cars and light trucks.(1) Beginning with the 1982 Model Year, this standard is 0.60 gram per mile for both diesel-fueled light duty vehicles and light duty trucks. In 1985 the standard drops to 0.20 gram per mile for diesel fueled light duty vehicles and 0.26 gram per mile for light duty trucks. EPA adopted these standards because diesel-fueled engines emit approximately 30 to 70 times the amount of particulate emitted by gasoline-fueled engines equipped with catalytic converters, and as diesel-fueled vehicles assume an increasing portion of the light-duty vehicle market, their contribution to ambient TSP and fine particulate levels will increase. Many areas of the country were already unable to meet the primary National Ambient Air Quality Standard (NAAQS) for total suspended particulate (TSP) matter. EPA anticipated that between 15 and 25 percent of all new light-duty vehicles and trucks sold by the late 1980's would be powered by diesel engines.

The 0.20 gram per mile standard for 1985 was based on a determination by EPA that some form of after-treatment technology would be available by that time.

EPA expected trap-oxidizers to be the preferred after-treatment technology. A trap-oxidizer is simply a trap with a mechanism by which the collected particulate is oxidized to regenerate the trap and to maintain the collection efficiency and exhaust gas backpressure at acceptable levels.

Assuming that market penetration for diesels rises to 15-25% (actual-1990 light-duty fleet being 10-17 percent diesel), these standards will reduce particulate emissions from light-duty diesels by 74 percent in 1990 with respect to what would be expected without these regulations. Nation-wide particulate emissions in 1990 from light-duty diesels will be reduced from approximately 152,000-253,000 metric tons per year to 40,000-66,000 metric tons per year. Emissions in urban areas from these vehicles will also decrease 74 percent in 1990 from 84,000-141,000 metric ton per year to 22,000-37,000 metric tons per year. This emission reduction will reduce ambient light-duty diesel particulate levels in large cities (e.g., New York, Chicago, Los Angeles) from 2.0-11.3 to 0.5-2.9 micrograms per cubic meter. Light-duty diesel particulate levels in smaller cities (e.g., St. Louis, Pittsburgh) will also decrease from 1.5-7.5 to 0.4-1.9 micrograms per cubic meter. Localized levels which occur over and above these larger-scale impacts will also decrease from 5-9 micrograms per cubic meter to 1-2 micrograms per cubic meter. These latter impacts could occur as far as 90 meters away from very busy roadways.

Beyond the significant TSP improvements that were expected from these regulations, EPA was also concerned about two special aspects of diesel particles which made them of particular concern — their small size and their composition. Small particles, which are much more likely to be deposited in the alveolar region and which require much longer periods of time to be cleared from the respiratory tract, have a greater potential to affect human health than larger particles. Thus, control of diesel particulate, of which 100 percent is less than 15 micrometers in diameter and approximately 97 percent of which is less than 2.5 micrometers in diameters, were considered especially important with respect to human health. The chemical composition of diesel particulate emissions, as the extractable organic fraction of diesel particulate, had been shown to be mutagenic in short-term bioassays.

What has been our experience since these rule was adopted by EPA? First, while motor vehicle sales this past year are the lowest in twenty years (2), diesel car sales continue to climb. In 1981, diesel car sales climbed 32 percent over 1980 levels (3). While projections for future diesel sales are subject to considerable uncertainty, all such projections estimate that diesel sales will increase dramatically over 1981 levels. Recent estimates (4) project that anywhere from 13 to 14.6 percent of all passenger car sales in 1985 and from 18.8 to 25 percent by 1990 will be diesel. The estimates for 1990 could increase to over 29 percent if real fuel prices increase more than currently anticipated during the mid to late 1980's (5).

At the same time the emission control industry and auto companies have made tremendous strides in the development of trap-oxidizers. Collection efficiency has been improved, and operating systems have been developed that are compatible with a full range of driving modes. Perhaps the most significant developments have been the recent dramatic successes with regard to system durability. For example, Johnson Matthey, Inc., has recently completed a test in which a vehicle equipped with a trap-oxidizer was operated for 50,000 miles with emissions below the 0.2 gpm diesel particulate standard, as well as applicable HC, CO and NOx standards (6). It has also been reported that "there are 82 cars between 20,000 and 60,000 miles that have or are currently being run with various manufacturers trap designs".(7). Johnson Matthey also has informed EPA that it anticipates making available for testing and research purposes a supply of traps for pre-production vehicles-at a rate of 100,000 units per year by April 1982, and that within 12 to 18 months of receiving its first order it could be producing units on an annual rate of 5 million.(8).Further, even without traps, manufacturers have made very dramatic progress in reducing particulate emissions. A few vehicles have even achieved 0.2 gpm, but more significant may be the fact that many of the larger vehicles are already achieving levels between 0.3 and 0.4.

With regard to the impact of diesel particles on public health and welfare, the recent report from the National Academy of Science (9) indicates that we should continue to have grave concerns. The Academy notes that "because of their small size, (diesel particles) remain suspended in the air for a week or more and they can be inhaled and deposited in the narrowest passages of the lungs. Because of their small size, however, they offer a relatively large surface on which toxic, mutagenic, and carcinogenic compounds can be absorbed." As Dr.Wei, Professor of Toxicology at the University of California, Berkeley, recently pointed out to EPA Administrator Gorsuch, "diesel particulates contain a potent class of cancer-causing substances called nitroaromatic compounds...greater public exposure to these nitroaromatic compounds...will be detrimental to the public's health."(10) A careful review of the NAS report would indicate that without further control, the likelihood of zero cancer risk is very small. The greatest likelihood is hundreds of excess cancer deaths per year; maximum effects are thousands of deaths per year. In the face of this evidence, the prudent public policy clearly is to control these emissions to the degree possible.

Independent of the cancer risks, the NAS indicates other reasons for concern about diesel exhaust. For example, "Greater numbers of diesels in localities already experiencing photochemical smog may increase the conversion of gaseous sulfur oxides to sulfur containing aerosols. This possibility presents a health concern because high levels of SO2 and coexisting particulate pollutants have been associated repeatedly with increases in respiratory morbidity and mortality rates."

In addition to the direct health concerns noted above, diesel particles can have a potentially devastating effect on visibility. Again referring to the recent NAS report, it was noted that Denver could experience a 50% reduction in visibility when diesels comprise 25% of the total automobile fleet. In Southern California, visibility impairment of about 20% would result. The Academy noted that "The severest loss invisibility from a large increase in diesel cars is likely to occur in the street canyons of urban centers such as New York City." While not specifically noted by the Academy, this admonition presumably would also apply to Chicago, Baltimore, Pittsburg, Cincinatti, and Detroit to name but a few. Further, in recent comments to EPA, the United States Department of the Interior pointed out that "western parks such as Grand Canyon, Zion, Bryce, Yosemite, and Canyonlands are being affected by the long range transport of urban plumes. A major component of these plumes is automobile emissions. Hence, any increase in emissions from diesel automobiles could have additional adverse effects on these parks". (11)

While the NAS report contains a good, although slightly out of date assessment of health and welfare problems associated with diesel particulate emissions, certain portions of the analysis are seriously deficient. Although the idea of conducting a good cost-benefit analysis continues to sound attractive in theory, the NAS study reinforces my view that it is difficult to do so in practice given the many unknowns and that it can easily result in policy conclusions which are erroneous. For example, based on an assumption that cars on the road will be heavier if dieselized than if not (a very soft assumption to start with since manufacturers are currently exceeding the Federal fuel economy standards by a significant amount and could easily shift to large gasoline powered cars if there was a market demand), the Academy estimated that "there might be about 800 fewer road deaths per year if 10 percent of the automobile fleet consisted of diesel cars that are larger and heavier than the same percentage of gasoline fueled cars replaced." Other factors such as seat belt usage, higher or lower speeds, more or less trucks, new NHTSA safety standards etc. were not considered. In addition, empirical evidence contradicts the assumption that passenger car safety is incompatible with lower vehicle weight and size. From 1977 to 1981, subcompacts went from 27% of new car sales to 43% and compacts went from 14% to 20%. Meanwhile, passenger car fatalities have been going down, decreasing by 1 1/2 % from 1978 to 1979 and another 1 1/2 % from 1979 to 1980. Less weight does not automatically equate to loss of safety.

In another area, the Academy points out that "The experience of developing catalyst systems for 1975 model passenger cars suggests about a five-year lag between the design and demonstration of such a device and its production and commercialization." In considering that comment I think it is fair to state that most of the data collected by the NAS Technical Panel was collected prior to the summer of 1980, about two years ago. In addition, most of the available information at that time came from the automobile manufacturers themselves. Without imputing the motivations of the manufacturers, I do think they would tend to be less optimistic than you might be about the feasibility of emission controls. I also urge you to look to past experience with catalytic converters for insight into technological feasibility issues. I remind you that as late as March of 1973, General Motors predicted "business catastrophe" if forced to install the catalyst.(12) Less than two months later, GM declared that "catalytic converters are providing good emission control efficiency and durability."(13) As you know, GM subsequently decided to install catalysts on 100% of their 1975 production and was able to achieve tight emissions standards with improved fuel economy. Based on recent test results with particulate control devices, we appear to be at least as far along today if not further along than we were in 1972 in developing devices to be placed on 1975 gasoline cars.

The Academy also seems to conclude that significant particulate control effort would continue even in the absense of a standard. I emphatically disagree! As EPA noted in the preamble to its rule, "Particulate emissions are a classic economic externality for the automotive industry. Left to the marketplace, it is extremely unlikely that sufficient pressure would be brought to bear on the industry to aggressively pursue trap oxidizer development. Experience has shown the greatest emission control development work to have taken place when direct regulatory incentives were in place."(14) The point was made even stronger in a recent meeting between EPA and trap-oxidizer developers, "if the current diesel particulate regulations are relaxed...the possibility for clean diesels will disappear because we will have to withdraw from this effort." (15)

While I have perhaps been harsh with the NAS, I should note that some elements of its analysis are quite constructive and should be scrutinized closely by you. In particular, I would direct your attention to the recommendation regarding particulate standards for diesel trucks and buses. While standards were proposed for these vehicles by EPA in January 1981, no further action has been apparent since that time. In the case of these vehicles, we are not dealing with a prospective problem but one that exists right now. Most heavy, over the road, trucks are already diesel, and those of medium size range are rapidly converting. The NAS advice that "Accellerating the control of heavy duty diesel emissions should be a high priority" seems soundly based and I believe it should be heeded.

That concludes my prepared statement. I would be happy to try to respond to any questions you might have.

REFERENCES

1.Federal Register, March 5,1980, Standard for Emission of Particulate, Regulation for Diesel Fueled Light Duty Vehicles and Light Duty Trucks

2.Automotive News, January 11, 1982.

3.Automotive News, November 30, 1981.

4.NHTSA, personal communication, January 8, 1982; the Highway Fuel Consumption Model, Fifth Quarterly Report, Prepared for Office of Policy Planning and Analysis, U.S. Department of Energy, November 30, 1981.

5.The Technology/Cost Segment Model Post-1985 Automotive Fuel Economy Analysis, Final Report For U.S. Department of Energy, Office of Conservtion, November 7, 1981.

6.February 12, 1982 Letter from Dr. George McGuire, Johnson Matthey,Inc. to Administrator, U.S. Environmental Protection Agency

7.Memo from Maureen D. Smith, March 15, 1982 Record of January 27,1982 Meeting with the Manufacturers of Emission Controls Association on Trap Oxidizers.

8.Memo from Maureen D. Smith, March 15, 1982 Record of January 27,1982 Meeting with the Manufacturers of Emission Controls Association on Trap Oxidizers.

9.Diesel Cars, Benefits, Risks and Public Policy, National Academy of Sciences,December 1981

10.Letter from Dr. E.T.Wei,Professor of Toxicology, University of California, Berkeley to Administrator,U.S. EPA, January 29, 1982

11.Letter from Bruce Blanchard, U.S.Department of the Interior to U.S. EPA, March 10, 1982

12.March 12, 1973, Testimony of General Motors before U.S. EPA

13.May 9, 1973, Letter from President of General Motors to U.S.EPA

14.Federal Register, March 5,1980, Standard for Emission of Particulate, Regulation for Diesel Fueled Light Duty Vehicles and Light Duty Trucks

15.Memo from Maureen D. Smith, March 15, 1982 Record of January 27,1982 Meeting with the Manufacturers of Emission Controls Association on Trap Oxidizers.

Mr. **Gore**. Very good. Mr. Volkmer.

Mr. **Volkmer**. I am sorry I missed some of the testimony. I had to be out for a while. What concerns me I guess a great deal is some of the statements that I have read at least as to the state of art as to perfecting trap oxidizer or other equipment that would reduce the particulate emissions. Does anyone know or have they cited any other instances other than the Johnson-Matthey emission control trap oxidizer test? Does anybody have any other information on any other either equipment or testing?

Mr. **Walsh**. Yes, Mr. Volkmer. In comments before EPA, as EPA has been reviewing what has been accomplished since the rule was adopted, statements were made that many devices are currently undergoing review. I think it is fair to say that there really have been three critical issues in terms of meeting and demonstrating the workability of the 1985 standard. The first is collection efficiency, and I think there is no longer any dispute that traps that can collect at very high levels of efficiency are available from various manufacturers, and I think you will hear from some of them later today.

I think the second issue is the durability. When EPA adopted the rule, the only piece of data beyond 10,000 miles I believe was on an Opel, which had gone about 12,000 miles. Now we have not just the one system that has gone 50,000 miles, but other systems that have gone for extended mileage.

The last issue really that I think remains to be resolved is the regeneration process, and that is where I think a lot of the work is going on right now.

Mr. **Volkmer**. That is what concerned me, by reviewing the Johnson-Matthey test, the questions of regeneration, and the process that had to be followed by the individuals operating the vehicle in the regeneration is not one I do not think that most of the general populace would be willing to go through. In other words, if they had to operate a vehicle and use a process of regeneration manually, et cetera, I question whether they would ever buy that vehicle. Do you agree there would be a question of purchasing a vehicle if it had to be so operated?

Mr. **Walsh**. I don't think that anybody would consider that as the final regeneration system. The purpose of that test was to demonstrate that a track would be durable for 50,000 miles and meet the standard. I think that is the kind of technological development, because it is such an integral part of the vehicle, itself, that only the manufacturers can do the work on, that outside suppliers can develop components such as traps to go on the vehicles, but the regeneration is an integral part of the engine, really, in a lot of ways, and that is where I hope and expect that the manufacturers are putting a lot of their effort right now.

In the California testimony, the General Motors representative pointed out a lot of the work that they are presently doing, and I was impressed with the scope of it, and hope if they are encouraged by continued government regulation to stay with that effort, that over the next year or two, we will see the same progress we did with gasoline-powered engines during the seventies.

Mr. **Jouppi**. May I add to the question?

In my review, I have been in quite a number of laboratories, there is a common fault that automaticity would have to be added; that this would have to be a system without the owner needing to do anything especially.

Mr. **Volkmer**. Also, in other words, the question as to cost, as to replacement, in other words, the diesel engine is such, the power train, et cetera, is going to go usually a minimum of 100,000 miles.

Are we going to have to replace one of these oxidizers? That was a Volkswagen at Johnson-Matthey; was it not?

Mr. **Walsh**. Yes, we are in the same, perhaps even a little better state of development as we were with catalysts during the early seventies.

We were seeing a lot of the catalysts at that time melting when you didn't control the temperatures correctly on the vehicle.

Mr. **Volkmer**. This is happening in the regeneration process with an oxidizer, too; is it not?

Different types of equipment have been attempted, even with ceramics?

Mr. **Walsh**. If you don't keep the temperature of the exhaust within a certain window, you can cause problems.

That is probably true without a catalyst or a trap oxidizer.

It is a fairly straightforward process to maintain a window in that exhaust system.

The point I was going to make in the early seventies, we were about in this same place when we were talking about a standard that would go into effect in 1985.

I think that the engineering expertise in the motor vehicle industry, in my judgment, is outstanding, and I really don't have great misgivings about their ability to develop these systems if they continue to work on them.

Mr. **Volkmer**. I think my time has expired.

Mr. **Gore**. Mr. Walker?

Mr. **Walker**. Could you give us some idea as to what you believe are some of the economics benefits that result from increased use of diesel?

Mr. **Jouppi**. The economic benefits would not accrue, in my view, unless there were a disparity in the price of the fuel, as diesel fuel is intrinsically less expensive than gasoline, and it would seem that the marketing push for diesel-powered automobiles came from this desire for economy of fuel, and with some, and this is a particular fleet owner, and one of my fellow witnesses here at the table has brought this forth, that there is a desire on the part of people to have a larger vehicle, and still have the fuel economy; so that if this were to take the place, one could put a percentage of added benefit to the consumer by going to diesel, if all of the matters of health, and so forth, were taken care of.

It would be a factor that would increase the economic value of the vehicle to the consumer.

Again, it would do that in two ways: One, in less fuel costs, and the other is in providing more car per dollar.

There is in our own work with dealers, and so forth, there is some thought now that diesel development up to this point in passenger cars has not come close enough to what is felt to be the traditional long truck, of the truck type longevity; that there is still the problem not yet completely known of what it might cost in the long run to maintain the vehicle.

Mr. **Walker**. Let me follow up. You have indicated the cost of the fuel would be a factor. Isn't there also an efficiency factor with regard to use of fuel in diesels that becomes a factor in the economy even in small cars, the efficiency factor is considerably more than at least the present internal combustion gasoline type engine?

Mr. **Jouppi**. I would have to agree with that.

Mr. **Walker**. Isn't that factor something in the range of 20 to 30 percent?

Mr. **Jouppi**. I could not disagree with the percentage, but from the national use of energy, it obviously is more economical.

Mr. **Walker**. Mr. Walsh?

Mr. **Walsh**. Yes, Mr. Walker, I agree very much with that point, and not only to the individual consumer, but to the country as a whole, diesel does present an opportunity to bring about fairly significant energy savings, because there is no doubt about the fact that it is a very efficient powerplant.

I would add that my experience in dealing with the public on this issue leads me to conclude that the opportunity for maximizing these energy savings is increased if we control the particulate and the smoke.

One of the disadvantages of the diesel vis-a-vis gasoline vehicles is that you can see its pollution, and fairly or not, it suffers from that and a lot of the public complains about that, and if that problem is solved, which I hope it will be and expect that it can be, we can really optimize and maximize the energy savings that we can get for this country.

Mr. **Walker**. Isn't there a secondary benefit that accrues from the fact that you could eliminate, for instance, platinum imports from South Africa and the U.S.S.R. that are needed for catalytic converters through the use of diesel?

Mr. **Jouppi**. That is a factor. There is certain work being done now on baser metals and also for recycling.

We have not reached the point of full technology yet, full fruits of the technology in the use of the platinum. We have been able to get along with less and less of that, and certainly if we could get along without a scarce resource, that we would have to import from a country that was not necessarily friendly toward us, that would be an advantage to the country, no question.

Mr. **Walker**. Wouldn't there also be some secondary economic problems associated with the fact that some companies, General Motors for one, Volkswagen for another, has put a lot of developmental costs into diesels, if they were not able to continue on market in any way, that that would have some adverse economic impact in terms of investment dollars that have already been spent and, therefore, would not be able to be used?

Doesn't that have a rather broad-based economic impact?

Mr. **Jouppi**. That certainly is. In the automobile industry, itself, over the past year, past 10 years, has had to spend $60 billion, a bit more for capital, and so forth, and much of that did not get its full life use, because we moved with the energy crisis of the fall of 1973, the Energy Act of 1975, downsizing, and so forth.

Much of the V-8 type capacity that was put in was not fully used before it had to be abandoned then. That is always a risk, and one reason from a Wall Street viewpoint why the automobile companies and the stocks do have a price earnings ratio penalty with respect to industries where their markets, or with respect to equity markets where there is a more predictable future.

Mr. **Walker**. My point is simply this: In other words, there are some broad-based economic impacts, at least within the automotive industry, from any decisions that we make with regard to diesel at the present time?

Mr. **Jouppi**. No question about that.

Mr. **Walker**. Yes, Mr. Doniger?

Mr. **Doniger**. Even with the maximum penetration of diesels into the market, you are still talking about having 75 percent of the vehicles run on gasoline, and those will all require catalysts, and we are not going to eliminate that problem by going diesels. We might possibly moderate it a tiny bit, but if you go to one of the more advanced trap designs, that needs platinum, too. No more, or not in significantly different amounts, than the catalytic converters.

Mr. **Walker**. That is if we increase the standards with regard to pollution?

Mr. **Doniger**. Yes, but we could also eliminate the need for catalysts altogether by going back to the uncontrolled state of gasoline cars which will allow us even to go back to leaded gasoline; but the point of not doing that is, there are health problems associated with that, very serious ones.

We feel that we have the same type of problem, perhaps even a more severe one, with respect to the diesel particulate.

Mr. **Walker**. I understand, except I would say to you that from the standpoint that I am coming at to Mr. Jouppi, there would be a considerable economic disadvantage to eliminating the air pollution standards at the present time, because we have already developed that technology, and it is already on line, and being used, and to have that taken off does not make much economic sense, either.

In this case, we are talking about a whole new technology, or perhaps if the new technology can't be used, eliminating the diesel technology in passenger cars, and that does present a different set of economic questions.

Mr. **Doniger**. The last point is the one I wanted to hit. No advocate in this whole debate, except General Motors and some of the automakers, is talking about the possibility of eliminating the diesel car. It is funny to see that position taken by the company. They are the only ones who contend that the standard could be at a point which would eliminate the car.

What we are saying is if good-faith efforts are made—and I personally feel some equivocation as to whether we are getting such efforts—and we get to the point where the decision had to be made whether this technology gets put on the 1985 cars, the standards can be relaxed if need be. But the pressure ought not to be lessened now.

You are not faced with a choice now of sticking with the standards or eliminating them now, doing away with diesels or keeping diesels.

It is just not a real choice.

Mr. **Volkmer**. Will the gentleman yield on that?

Mr. **Walker**. I will be very glad to. My time is running out. I do think that there is a question of investment costs here.

The automobile industries are strangled, whether it be GM or anybody else, are strangled right now for investment moneys. If there is an indefinite quantity about 1985, that is why they say they can't eliminate diesel as an option if they are not certain they will be viable on the market by 1985, and that is a question of considerable investment in order to keep them viable to the market in the 1985 time frame.

That, then, becomes an economic decision within the company on scarce resources, and I do think that there is a danger that you then could lose the diesel technology which, as I pointed out, has considerable economic benefit.

Mr. **Doniger**. The Trade Press, Automotive News, and some of the others, contains lots of information about the firm, speculative and rumored plans among the automakers, what they might or might not be introducing 3 or 4 years down the line.

I have not seen one article, except in the context of describing the companies' position in this regulatory proceeding, which even suggests that diesel would not be the major part of the picture for the late eighties and nineties.

Mr. **Walker**. I do know, for example, that decisions have been made internally by a couple of companies to drop diesel already. Ford has decided not to go through with it. GM made a decision to drop the development of their three-cylinder diesel. There are a number of decisions like that that are being made with regard to diesel, cancelling the option.

Mr. **Doniger**. Those decisions are not turning on the question of the regulatory standard because everybody must realize when it comes down to the beginning of 1985, the standard will bend if it has to.

What we are saying is, don't bend the standards so early; that the technology will advance, if the push of regulations is maintained.

Mr. **Walker**. If I am an investor, I don't have very much faith in making my investments, that the standard will bend if it has to.

I am going to make my decision based on what is, not what might be. I will be glad to yield to the gentleman.

Mr. **Volkmer**. Do you have knowledge as to the time frame in which the auto manufacturer, whether it is GM or any foreign automobile manufacturer, has to decide on the 1985 models sometime around October of 1984, less than 2½ years, to decide whether or not to make these changes? My impression from you is that that can wait until 6 months maybe before that model is actually online and coming off the line.

I have some other opinions as to that, and I would like to know how you view that.

Mr. **Doniger**. I appreciate——

Mr. **Volkmer**. When these determinations have to be made?

Mr. **Doniger**. It is a very important question and at pages 13 through 15 of my testimony, I deal with some of the statements that General Motors has made in its petition to EPA for suspension of these standards regarding lead time, and I can only react to what the auto companies put forward as their argument for why they haven't enough time. At each step in that argument, there is a lot of "fudge."

A couple of examples. GM is talking about "good engineering practices" which would have required them, they say, to make decisions on the final shape of the control technology for these vehicles already. There is no precedent for having that much lead time before. In the decisions on catalyst vehicles were much tighter. They were made much more closely to production date.

You also have to imagine this as a sequential decision. You got to make major decisions early and relatively less major, minor decisions, very late in the game, and the decisions about which trap to use, what design—those can be put off now. There is another year left before those decisions have to be made.

Mr. VOLKMER. We don't have, and, as I understand it, I have not heard yet one oxidizer trap that will work automatically on a car without any intervention, say, for 50,000 miles on an engine any larger than the Volkswagen Rabbit.

Mr. DONIGER. I concur with Mr. Walsh that that is a relatively straightforward engineering problem made substantially easier by the experience we had during the seventies with developing computerized and other electronic controls for the gasoline cars.

It is within the sole capability of the auto manufacturers to do those demonstrations, and they have a record of not doing those demonstrations where it is of regulatory advantage to them not to have them.

I will stop there.

Mr. VOLKMER. Thank you.

I thank the gentleman.

Mr. WALKER. Mr. Walsh, you wrote the diesel particulate standard. I understand you specifically said that it was not a health-based standard, realizing that particulates have an adverse effect. The state-of-the-art kind of standard would seem to be appropriate. Why, then, would you go to a technology forcing standard if health was not involved?

Mr. WALSH. To clarify what we did, we set that standard under a provision of the Clean Air Act that we read as requiring us to set it on the basis of what we felt was technologically feasible. We went through great detail in our regulatory analysis to point out, however, that we had several, as I indicated a little bit in that one here today, health concerns with the diesel particles.

We didn't ignore health standards in setting that standard, but we didn't set it on a basis of a number that we felt was wholly protective of public health, but we set it on the basis of what we felt was achievable in that time frame.

Mr. WALKER. Technology forcing standards usually required a health-based type of criteria whereas when you are dealing with something that involves esthetics, or whatever, then state-of-the-art becomes a functional reality. That is my question.

Why go to technology forcing in this particular instance?

Mr. WALSH. We felt then, and I certainly feel now, that there is a very legitimate health basis for setting a standard for these diesel particles.

Fine particulate in and of itself is a health concern. Many scientists continue to be concerned about the potential carcinogenic impacts, and the welfare concerns are very dramatic. From any of these standpoints the need for the standard is well demonstrated.

If you read the Academy report, if you read any of the information that was provided to EPA by people in the health community, Mr. Doniger referred to the statements of several eminent health scientists that recently petitioned the EPA in this regard. I want to be sure I am not being at all ambiguous about my opinion that there is a very strong health need for a particular control.

Mr. **Walker**. There is a recent article from April of this month in the Wall Street Journal which says—this sentence is:

> Incredibly though, even EPA admits that tests on animals have yet to prove any serious problem traceable to diesel exhaust.

Mr. **Walsh**. As I went through the analysis of diesel particulate health effects, it took us over 20 years to get positive experimental results from animals with cigarette smoke.

In the case of cigarettes, we had a large human population being exposed and a whole host of illnesses being incurred.

I have talked to many of these people that have conducted these health experiments and tried to get a very good feel for the sensitivity of these experiments, and you have to look at them in that light. When you look at the body of evidence we have on the size characteristics, the chemical composition of diesel particles, I think if you get a cross-section of the health community, you will find, as I did, that there is a very strong basis for being prudent in controlling those particles.

Mr. **Walker**. We have a British study and some of the methodology of that has been criticized, I know, but nevertheless, statistically, it seems to show that the people who have been exposed to diesel exhaust over a long period of time, and, you know, are intimately working with it over a long period of time, did not have marked health defects any different from the population as a whole.

Mr. **Walsh**. Mr. Doniger may have some comments to add to mine on this, but if you look at that study carefully, as even the National Academy of Sciences did, you could have thousands of people each year in the United States suffering cancer deaths due to diesels, and you would not have picked it up in that study.

It is not a sensitive study, and it didn't take into account things such as smoking histories, which it could not.

Epidemiological studies with small groups of people are very, very insensitive.

Mr. **Walker**. When you put that together with what we have on the National Research Council, health effects of the exposure to diesel exhaust, they say flatly:

> However, no evidence of carcinogenesis has been noted in animals breathing diesel exhaust fumes, nor in epidemiologic studies of heavily exposed human populations.

Mr. **Walsh**. In some of the in vitro studies that have been conducted, it is mutagenic. There are some animal studies that have found tumors, and it is bioassayable.

When it does get ingested into the animal's lung, it is turning up in other parts of the body.

Mr. WALKER. The only way that they got that was to take the particles apart and use the particles, use elements from the particles when painted on the skin of some of the animals in order to get the mutations.

Mr. DONIGER. I don't believe that is correct. That is one type of experiment that has been done, but it has been demonstrated in other experiments that when people and animals breathe this stuff, it can come off the particles in your lungs; then it can get from your lungs to other parts of your body.

Mr. WALKER. But I am correct that, in fact, the studies of the particles and actual exposure to particles have turned up, and, as I say, the National Research Council said in their report that:

> No evidence of carcinogenesis has been noted in animals breathing diesel exhaust fumes, nor in epidemiological studies of relatively heavily exposed human populations.

Is that not a fact as to what they said?

Mr. DONIGER. The testimony of General Motors 2 years ago, before your subcommittee, was that the London study which you referred to could not find the kind of effects that would be of great concern here in the United States

The General Motors witnesses admitted that. The National Research Council report, in the discussion of that study itself, corroborates that.

As for the human experiments, I just reiterate, we have with smoking a 100-year history of people exposed to cigarettes, and that gives us a tremendous epidemiological data base of tragic proportions to figure out what cigarettes are doing to people's health.

It took them until a few years ago to demonstrate in animal experiments that smoking caused cancer.

We should not disregard that all the evidence that diesel particles may be a serious health problem because we do not have 100 years of human study.

Mr. WALKER. The National Research Council, the one firm study that we have, makes it very clear that the real issue is the following:

> Because diesel exhaust is one of many sources of air pollution, the relevant issue is the risk to human health from the incremental contribution of diesel exhaust constituents to the existing state of the air.

That is the key question.

Mr. DONIGER. Correct.

Mr. WALKER. When that question is asked in terms of the scientific studies that they did, their answer is that it does not pose an additional risk?

Mr. DONIGER. The Academy did no studies. The Academy is merely a review of prior studies, and among th studies that they looked at, and should have looked at more carefully, in my opinion, are ones referred to in the letter to Anne Gorsuch by the eight scientists, which is appended to my testimony.

Mr. WALKER. You didn't agree with the methodology that they used?

Mr. DONIGER. This is an analysis which is based on taking the exhaust particulate and comparing what was in it to what is in coke oven emissions and what is in cigarette smoke. From this can be made some suggestions of what its potency is for causing cancer, compared to what we know from unfortunate human experience, with the cigarette smoke and coke oven emissions. That analysis supports an upper-bound risk of up to 8,000 lung cancers a year.

Even if it is half, or a quarter, or even a tenth of that level, it is a very disturbing thing to me and to many Americans.

It seems to us that then it makes sense to take preventive health measures to avoid ever finding out whether that is the case. You don't want to ever find out what happened, because that would mean that it had happened already, and we exposed people for 20 or 40 years to this stuff in order to find out, and that would be awful.

Mr. WALKER. What we discovered the last time we held hearings on this subject was so much of what we were hearing on the health side of it was that the people who talked about the studies all came in and said yes, and true that the studies haven't shown anything conclusive; but we disagree with the methodology and the studies. That is going to be constantly the process here.

We are trying to seek a way that we can preserve what I regard to be an economically beneficial technology, and do so in a way that does speak to valid concerns about diesel exhaust, and if there are, in fact, health problems, they should be spoken to, but the question becomes here whether or not you use technology-forcing standards where you don't have that kind of evidence.

Mr. WALSH. I think that my sense of the public policy issue here is that we really have two or three different choices in terms of diesels. We could, first, say as a country, we will not allow this technology to go into the hands of the public until we have conducted a battery of experiments that take multiple years that convince everybody that there is no adverse health effect. The alternative is to say, we will ignore the kinds of health concerns that many scientists have raised, and which the National Academy of Sciences study raises in three different areas.

The third alternative is to allow the technology to proceed, and to try to as a country get the advantages of that technology from an energy standpoint and others and at the same time apply prudent regulatory approaches to control the things that we think are causing these adverse health effects to the degree that it is possible without eliminating the technology.

I agree with the point that Mr. Doniger raised before. EPA is very explicit in saying it did not intend, and I don't think it has changed in this regard, to ban the diesel technology, and I think the regulation is the right course of action to foster the development of technologies that will eliminate that which I think prudent scientists will conclude presents a risk of public health problem.

Mr. GORE. Without objection, I would ask unanimous consent that we also include the Staff Summary of the Health Effects Preserves that has been done on diesel and diesel extracts.

[The information follows:]

HEALTH EFFECTS OF DIESEL EMISSIONS

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ISSUE DEFINITION

The Clean Air Act (CAA) is undergoing the process of reauthorization. Among other things, it provides for the protection of health and general welfare from the detrimental effects of emissions from mobile sources. There are currently thousands of vehicles in operation that are powered by diesel engines, and major automakers are projecting a significant increase in the number of diesel-powered vehicles in the near future.

The air pollutants emitted from these engines differ in composition from those of gasoline engines. The health effects of diesel emissions may also differ from those of gas engines. Should the fleet size of diesel-powered vehicles increase, any incidence of harmful health effects from diesel emissions might also be expected to increase. This issue brief summarizes the current understanding of the health effects of diesel emissions, an important consideration in the reauthorization of the Clean Air Act.

BACKGROUND AND POLICY ANALYSIS

The automobile is a significant contributor to air pollution in metropolitan areas; it is also a major consumer of energy. Competing interests of stimulating a languid economy, cleaning the environment, increasing energy independence, expanding job opportunities, and rationalizing regulations constitute the current conflicts involved in reauthorizing the Clean Air Act. (Several issue briefs are available on the Clean Air Act -- see IB80078, Clean Air Act: An Overview; IB81126, Clean Air Act Amendments and the 97th Congress; and IB81135, Clean Air Act: Mobile Source Emissions.)

As a crucial element in the effort to meet Projected Corporate Average Fuel Economy standards, return and maintain profitability to the domestic automotive industry, and reduce certain engine emissions, the major auto companies increasingly are turning to the diesel engine as an automotive powerplant of choice. The largest car-maker expects at least one of every four light-duty vehicles it sells at the turn of the century to be diesel powered; the entire U.S. car fleet (which in the 1970s had fewer than one diesel in 200 cars) is expected to reach the 25% dieselized level by 1990. Two-thirds of new trucks and buses will be diesel powered by 1990 (in the 1970s the figure was about one-quarter). The increasing interest in and use of the diesel engine stems from certain unique operating characteristics.

The Diesel Engine

For a given volume of fuel, a diesel engine can extract more energy than a gasoline engine. Additionally, there is more energy in a given volume of diesel fuel than in a comparable quantity of gasoline. A diesel engine is thus more fuel efficient than a gasoline engine. Being less volatile than gasoline, less diesel fuel is lost in handling and operation through evaporation. And less is lost through accidental fires since diesel fuel is less liable to ignite than gasoline. The savings benefit the individual owner and reduce the national petroleum appetite. Unlike gasoline engines, there is no need for conventional spark plugs in diesel engines, and diesel engines are able to meet current hydrocarbon and carbon monoxide standards without catalytic converters.

But the diesel also has unique negative characteristics. Current diesel engines emit 30 to 70 times the amount of particulates emitted by gasoline engines. Using a conventional catalytic converter can make a diesel conform to strict oxides of nitrogen standards, but the quantity of emitted particulates is increased. Further, the diesel engine comes in different sizes with differences in combustion characteristics. Diesel fuel comes in different grades and quality; owners may also put additives in their diesel fuel. In addition, different loads and different weather conditions affect diesel performance. All these factors cause changes in the composition of diesel emissions and complicate the task of assessing their human health effects.

Methods of controlling diesel emissions are numerous and varied. As mentioned, a catalytic converter can be added to reduce nitrogen oxides (NOx). TRW Corporation is attempting to adapt fabric filters from their present use in controlling particulate emissions from industrial sources to mobile sources. Johnson Matthey has developed a trap oxidizer that reduces soot and odor from diesel automobile exhausts; the device has been successfully tested for 50,000 miles on a 1982 VW Rabbit. A number of other firms are also testing trap oxidizers as controllers of diesel particulates. American Bosch Company is developing a more generalized emissions controller called ADECS, for Automatic Diesel Electronic-Control System. And Kyoto Ceramics, as another example, intends to build an inherently clean diesel engine made of ceramics and using very sophisticated technology; the engine still requires years of development. The reasons for the effort in controlling diesel emissions center on the possible health effects of those emissions.

HEALTH EFFECTS OF DIESEL EMISSIONS

Research into the health effects of diesel emissions has dealt with both whole diesel exhaust and extracts from whole exhaust. Whole exhaust consists of gaseous components, such as nitrogen oxides and carbon monoxide, and particulate matter (carbonaceous cores onto which are absorbed various materials such as polycyclic aromatic hydrocarbons and metals). The materials on the surface of the particulates have been removed and studied separately as the subjects of the extracts research. These materials are of great interest and importance because they are known to interact readily with biological systems, producing cancers, genetic mutations, and other physiologic effects. Both whole exhaust and extracts research have been performed in the United States and abroad -- foreign and domestic research tend to verify and complement each other. While much has been learned, much remains to be proven. The results of the research thus far can be summarized as follows:

Health Effects of Diesel Emissions

	Carcinogenicity	Mutagenicity	Pulmonary/Systemic	Optic
Whole exhaust	i	pp	i/pp	pp
Extracts	p	p	pp	pp

i equals inconclusive
i/pp equals inconclusive but proven in part in mammalian cell, bacterial, or animal systems
pp equals proven in part
p equals proven

(derived from NRC and EPA studies; see REFERENCE section)

Carcinogenicity

Whole exhaust. The cancer-causing power of whole diesel exhaust has been studied in two ways.

1. Studies involving inhalation of whole exhaust by research animals have been inconclusive so far in proving the carcinogenicity of whole diesel emissions. Owing to the time and cost limitations of animal studies, it is conventional research protocol to use a limited number of test animals subjected to elevated doses of the test substances for a relatively short time. This technique has not lead to conclusive results for two reasons. First, the elevated doses of whole diesel exhaust lead to acute toxic effects that mask and make difficult the determination of low (realistic) dose long-duration carcinogenicity. Second, the research animals are understandably uncooperative in these tests. The unpleasant smell, sooty nature, and general undesirableness of diesel exhaust, concentrated for the statistical workability of the research, causes a naturally uncooperative response by the test animals. This lack of cooperation takes the form of attempted escape behavior with all its consequent effects (shallow and rapid breathing, quickened pulse, hormonal and neurotransmitter changes, and general abnormal physiology). The treatment of test animals often has a pronounced effect upon test results and interpretation, and here renders even less conclusive the findings of carcinogenicity of diesel exhaust inhaled by test animals.

2. Epidemiological studies of those persons occupationally exposed to diesel exhaust have so far been inconclusive in proving diesel emissions carcinogenic. Not only have there been extremely few studies done, but the studies are similar in comparing very small populations and not controlling for various important factors such as smoking. In like manner, an epidemiological study of an urban population with a large diesel fleet has been inconclusive in proving the carcinogencity of diesel emissions owing to the lack of adequate controls. (See Minowa, et.al. in REFERENCE section.)

Extracts. The carcinogenicity of diesel exhaust extracts has been proven in three ways.

1. Researchers have injected intraperitoneal samples of diesel extracts into research animals and have observed unequivocal carcinogenesis.

2. Painting skins of test animals with diesel extracts has also indisputably proven carcinogenic activity.

3. Finally, many compounds extracted from diesel exhaust have been chemically analyzed and found to be similar or identical to compounds proven carcinogenic in other studies.

Carcinogenicity of the gas phase of diesel exhaust has not yet been proven. The bioavailability (i.e., the degree to which a substance can and will interact with a surrounding biological system) of the carcinogens in humans needs to be determined. And more chemical identifications of the constituents of diesel exhaust should be performed to better characterize the full carcinogenic potential of diesel exhaust.

Mutagenicity

Both the gas phase of and the extracts from diesel exhaust show mutagenic potential. Mutagenicity of each phase has been proven separately; the degree of mutagenicity of the two phases together has not yet been established. The number and detail of studies performed on the gas phase are substantially less than for extracts; the reliability of the proof for mutagenicity of whole exhaust is subsequently less than that for extracts alone.

Chemical mutagens are toxic substances which cause changes in genetic content. It has been shown that properly tested mutagens correctly predict carcinogenicity up to 90% of the time. The significance of proven mutagenicity is not only that these compounds can cause changes, and possibly detrimental ones, in genetic makeups, but can also cause cancer.

ulmonary/Systemic Effects

Epidemiologic and experimental evidence for detrimental pulmonary and systemic effects from exposure to whole diesel exhaust or extracts are presently inconclusive, or only partially prove a connection.

It is known that the carbonaceous particulates and the potentially hazardous compounds adsorbed to them do penetrate and accumulate deep in the lung. There, nonspecific histopathological changes have been observed; such changes include increases in nonfunctional fibrous connective tissue and partial destruction of the alveolar walls. With prolonged exposure, biochemical changes have been seen in organs distant from the respiratory tract. Resistance to infection appears to be diminished with chronic exposure. High doses lead to acute toxic effects.

Whether reversibility of lesions in the lung upon termination of exposure occurs remains to be demonstrated. The full story of the biological fate of inhaled diesel emissions remains to be written. Also, for those with pre-existing health problems, the interactions of diesel emissions and their direct health effects remain to be studied. And the different pulmonary/systemic effects arising from exposure to emissions of different composition coming from different types of diesels operating under different conditions on different fuel mixes require further research.

ptic Effects

Whole diesel exhaust and extracts are known to irritate eyes, causing lacrimation and reddening on occasion. There is also psychological discomfort caused by soot clouds and by the general reduction of visibility. Human dose-response, i.e., the degree to which people will respond to varying levels of exposure, is one factor not yet firmly established; there appears to be great latitude based upon individual preference. Economic, psychological, physiological, and biochemical studies are being undertaken to more clearly define the values and thresholds of increments of lost visibility and optic discomfort.

POINTS FOR FURTHER CONSIDERATION

New data that evaluate the benefits and costs of controlling diesel emissions have become available since the National Research Council's Diesel Impacts Study Committee released its report, Diesel Cars: Benefits, Risks, and Public Policy, Dec. 21, 1981. The study was begun in May 1979; the "collection of data and deliberation of findings and conclusions were completed for the most part... (by) August 1980." The report, which "on technical and cost grounds" recommended against the Environmental Protection Agency tightening the emission standard for post-1984 diesel cars and small trucks from the current 0.6 grams of particulates per mile to 0.2 grams per mile, "emphasized that the conclusions and analyses were developed during 1980." A number of important developments have occurred since then.

First, diesel control technologies have been refined, their costs have been reduced, and at least one device (a trap oxidizer) has satisfactorily passed the 50,000 mile durability test, maintaining the particulate emissions from a diesel engine below 0.2 g/mi for the entire test. The manufacturer of this device reports that the unit can be sold to automakers for less than 160 per unit. And since the trap oxidizer can also function as an acoustic muffler, the conventional muffler can be omitted, thus reducing the automakers' additional cost for meeting the 0.2 g/mi standard. A detailed analysis of the economic effects of controlling diesel emissions is beyond the scope of this issue brief. But since the NRC report relied on older figures which estimated control costs "from $150 to $600 per vehicle," it is clear that new analyses using current technical and cost information could now yield significantly different conclusions.

Second, studies are underway that indicate the cost of diesel emissions exacted from the aesthetics of cities and suburbs. People often object to the odor and lack of visibility that diesel emissions bring. Though it is difficult to place an exact value on what is lost when a locale is degraded by, say, diesel fumes, people are willing to pay a great deal to avoid, eliminate, or reduce the degradation of an area. In fact, recent studies suggest what such values are for given cities in the U.S., values that appear to be consistent throughout the U.S.

The following points, which were considered in the NRC report, continue to warrant further consideration.

(1) Better understanding and modeling of the physical fate of emissions is needed; atmospheric interactions with other pollutants, especially the interrelations in acid deposition and smog formation, require further attention.

(2) Monitoring of human exposure to pollutants is presently inadequate. eterminations of control strategies without a clear knowledge of what the real human exposures are appears to be barely justifiable.

(3) While the potencies of diesel extracts are fairly well known, the actual bioavailability and measured hazard of the substances in both the gas and extract fractions still require clarification and substantiation.

(4) The interactions of the direct health effects arising from exposure to diesel emissions with pre-existing illness and illness arising from exposure to other stresses need to be studied. Other stresses include emissions from gasoline engines; many components of gasoline engine emissions can be found in diesel exhaust, but there are differences in contents and concentrations, and there may be synergistic or other interactions possible in their combined health effects.

(5) The reversibility and/or stabilization of health effects upon termination of exposure to diesel exhaust needs further study.

All of these points serve to emphasize the need for detailed analyses of the effects arising from the protection of human health, visibility, and environmental productivity and aesthetics using current data and information.

LEGISLATION

(For information on auto emission legislation, see the following issue briefs: IB81126, Clean Air Act Amendments: 97th Congress; IB81135, Air Pollution: Mobile Source Emission Controls; and IB80078 Clean Air Act: An Overview.)

H.R. 5252 (Luken, et.al.) A Doc

Amends the Clean Air Act. The Administration has gone on record as being supportive of this approach to amending the CAA. Introduced on Dec. 16, 1981, referred to Committee on Energy and Commerce. H.R. 5252 proposes the relaxation of emission standards for mobile sources.

H.R. 5555 (Waxman)

Amends the Clean Air Act. The bill would retain the statutory HC and CO standards and would establish a 1.0 gram per mile standard for diesels in the 1985 model year. Introduced Feb. 22, 1982; referred to Committee on Energy and Commerce.

HEARINGS

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Rayburn 331 [illegible]

U.S. Congress. House. Subcommittee on Health and the Environment. Health standards for air pollutants. 97th Congress, 1st session. Oct. 13-15, 1981. Washington, U.S. Govt. Print. Off., 1981.

U.S. Congress. Senate. Committee on Environmental Public Works. Clean Air Act oversight. Hearings, 97th Congress, 1st session. Parts 1-7. Washington, U.S. Govt. Print. Off., 1981. 727 p.

759, 704, 750, 764, 866, 1016, 1278

CHRONOLOGY OF EVENTS

03/24/82-03/25/82 -- California Air Resources Board held public hearings on diesel vehicles in California.

03/12/82 -- Hearings on H.R. 5555 held by House Subcommittee on Energy and Commerce.

02/23/82 -- House Subcommittee on Energy and Commerce concluded hearings on H.R. 5252 (Congressional Record: D109).

02/22/82 -- Rep. Waxman introduced H.R. 5555.

01/20/82 -- The Administration endorsed H.R. 5252.

12/21/81 -- The National Research Council released Diesel Cars: Benefits, Risks, and Public Policy, recommending against the Environmental Protection Agency's tightening the particulates emission standard for Diesel cars and small trucks in 1985, based on technical and cost grounds.

12/16/81 -- Rep. Luken et.al. introduced H.R. 5252.

08/05/81 -- The Administration's Eleven Principles to guide the efforts in reauthorizing the CAA were announced by the Administrator of the EPA, Anne Gorsuch.

08/07/77 -- P.L. 95-95, the Clean Air Act Amendments of 1977.

12/31/70 -- P.L. 91-604, the Clean Air Act Amendments of 1970.

ADDITIONAL REFERENCE SOURCES

Journal of Applied Toxicology, vol. 1, no. 2. Mutagencity and carcinogenicity of diesel exhaust. Philadelphia, Pa: Heyden and Son. April 1981: 53-140.

Kaplan, I. Relationship of noxious gases to carcinoma of the lung in railroad workers. Journal of the American Medical Association, v. 171, 1959: 2039-2043.

Lave, Lester B. and Omenn, Gilbert S. Clearing the air: reforming the Clean Air Act. Washington, D.C.: The Brookings Institution. 1981.

Lewtas, Joellen (ed.). Toxicological effects of emissions from diesel engines. To be published in Amsterdam, the Netherlands: Elsevier/North Holland Biochemical Press.

Minowa, M., et.al. Geographical distribution of lung cancer mortality and environmental factors in Japan. Social Science Medicine, v. 15D. Great Britain: Pergamon Press Ltd. 1981.

The National Commission on Air Quality. To breathe clean air. Washington, D.C.: U.S. Govt. Print. Off., March 1981.

National Research Council. Diesel cars: benefits, risks, and public policy. Washington, D.C.: National Academy Press. 1981.

National Research Council. Health effects of exposure to diesel exhaust. Washington, D.C.: National Academy Press. 1981.

National Research Council. NOx emission controls for heavy-duty vehicles: toward meeting a 1986 standard. Washington, D.C. National Academy Press. 1981.

Raffle, P. The health of the worker. British journal of industrial medicine, v. 14:73-80.

Society of Automotive Engineers. Diesel combustion and emissions. Warrendale, Pa., Society of Automotive Engineers, Inc., 1980.

Society of Automotive Engineers. New diesel engines, combustion, and emissions research in Japan. Warrendale, Pa., Society of Automotive Engineers, Inc. September 1980.

U.S. Environmental Protection Agency. Guide to reduction of smoke and odor from diesel-powered vehicles. Washington, D.C.: U.S. Govt. Print. Off., September 1971.

U.S. Environmental Protection Agency. Health effects of diesel engine emissions: proceedings of an international symposium. Volumes 1 and 2. Cincinnati, Ohio: Health Effects Research Laboratory. November 1980. 1169 p.

CLEAN AIR ACT AMENDMENTS AND THE 97TH CONGRESS

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ISSUE DEFINITION

The Clean Air Act (CAA) has engendered much controversy. Its provisions to protect and enhance the quality of the nation's air have often proved difficult to administer and have at times appeared to conflict with other national priorities, especially economic growth and energy development. Critics charge that the Act imposes excessive red tape, leads to Federal interference in State and local decisionmaking, and imposes inefficient and unnecessarily stringent regulations.

Authorizations for the CAA expired at the end of fiscal year 1981. The reauthorization process has been seen by the Act's many critics as an opportunity for substantive amendments, although majority spokesmen of the legislating committees generally have spoken in terms of "finetuning" the Act rather than substantially overhauling it.

This issue brief reviews those proposed substantive amendments. It supplements issue brief 80078, Clean Air Act: An Overview, which summarizes the major provisions of the Act and establishes the context of the CAA issues.

BACKGROUND AND POLICY ANALYSIS

At the beginning of 1980, many congressional observers believed that amending the CAA would be one of the half-dozen major issues completed during the first session of the 97th Congress. That expectation was not only unfulfilled, but many now speculate that the process may extend into the 98th Congress. The House Subcommittee on Health and the Environment has held a number of hearings and began markup early in March; the Senate Committee on Environment and Public Works has been holding markup sessions, but progress has been slow.

Achievement of a concensus on comprehensive amendments to the Act has proved elusive (see "Lack of Consensus, Acid Rain, Administration Role Seen Key to Clean Air Impass," Inside EPA Dec. 11, 1981: 9-10). Nevertheless, the basic approaches to amending the Act are being defined today, and some substantive amendments have been offered: H.R. 5252, which includes amendments to both the stationary and mobile source provisions of the Act, proposes a number of changes in the Act that would simplify procedures and ease some requirements; it has the general support of industry and the Administration. (Much of H.R. 5252 is based on two earlier bills, H.R. 3761 and H.R. 4400.) H.R. 5555, the second set of comprehensive amendments, proposes changes that generally tighten provisions of the Act, while also simplifying several procedures; it has the general support of interest groups opposing calls for easing the Act's requirements. These bills will doubtless be the focal points of the House markup. No similar comprehensive bills have been introduced in the Senate, where markup so far has been based on the existing Act. On Feb. 24, 1982, however, Chairman Stafford proposed a series of amendments as a basis for discussion. Contrary to earlier expectations, the Administration has not submitted to Congress specific CAA amendments; instead, the Administration issued a series of 11 principles which it says should guide Congress in amending the Act. (Nevertheless, drafts of comprehensive amendments to the Act have leaked from EPA from time to time -- see Inside EPA, Sept. 11, 1981, Special Report.) Also, on Nov. 4, 1981, EPA presented a more or less official list of CAA "proposed changes" to the Senate Environment and Public Works; however, the Administration has not followed up on them, and more recently has been supporting H.R. 5252 as appropriate amendments to the Act.

One of the benchmarks for judging proposed CAA amendments is the report of the National Commission on Air Quality (NCAQ), which was created by the Clean Air Act Amendments of 1977 to review the working and success of the Act. Its membership included Senators, Congressmen, representatives of environmental groups, labor, industry, States, Indian tribes, and local governments, plus others chosen for their particular expertises. The Commission report, To Breath Clean Air, contained 109 recommendations, touching every part of the Act and reflecting "a general conclusion that the structure of the Clean Air Act is sound and needs refinement instead of fundamental changes."

Major provisions of the NCAQ report, H.R. -- including its predecessors H.R. 3471 and H.R. 4400 -- and H.R. 5555 and H.R. 5252 are summarized below. The Administration's principles are noted where appropriate.

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

The achievement of NAAQS, which set limits on pollution levels in ambient air, is the most basic requirement of the CAA. The Act requires the Administrator of EPA to set primary NAAQS at the level that, in his judgment, allows for an adequate margin of safety to protect public health; and similarly, to establish secondary NAAQS at a level to protect the public welfare.

National Commission on Air Quality. NCAQ recommended that the "current statutory criteria and requirements for setting air quality standards at the levels necessary to protect public health without consideration of economic factors should remain unchanged."

NCAQ further recommended that the EPA should continue to prepare analyses of the economic consequences of various levels considered (or of no standard). While these analyses would "include all reasonably identifiable costs and benefits to society together with any assumptions and uncertainties; they should not be used to determine whether or at what level the standards should be established." NACQ also recommended EPA continue to develop procedures for verifying crucial studies used in preparing criteria documents, and to refine risk analysis methodologies. NACQ recommended lifting the limit on the number of members of the Clean Air Scientific Advisory Committee who are appointed by the EPA Administrator.

H.R. 3471. This bill would remove the requirement that primary standards allow "an adequate margin of safety ... requisite to protect the public health" and substitute language requiring primary standards be set at the level "requisite to protect the public health from significant risk of adverse health effects." In addition, the Administrator is to prepare and publish an impact assessment which shall include an analysis of exposure, the consequences of that exposure, and the costs of attainment.

For secondary standards, the bill would change the level of protection from one of protecting "the public welfare from any known or anticipated adverse effects" to one of protecting "the public welfare from significant risks of any known or anticipated adverse effects." In addition, the bill would make "a comprehensive evaluation of the incremental costs and improvements in public welfare attributable to establishing such standard at various alternative levels" a basis for the standard chosen.

On the scientific validation of the criteria and standards, H.R. 3471 would require a critical analysis of the key studies and data used in the criteria document. Studies of questionable validity would have to be repeated. The Clean Air Scientific Advisory Committee would have to approve criteria documents before they could be published in final form. In addition, the bill would expand the committee, specify that it include an industry representative, and require the Director of the National Institute of Health, the President of the National Academy of Sciences, the Surgeon General, and the Chairman of the Council of Economic Advisors each to appoint a member.

H.R. 5555. This bill would leave unchanged the process of setting NAAQS, but it would require that EPA propose and set an inhalable particulate standard unless the Administrator determined one is not needed to protect public health.

Stafford Amendment. On secondary ambient air quality standards, the amendment deletes the word "any" from the requirement that a secondary NAAQS be set "to protect the public welfare from any known or anticipated adverse effect."

H.R. 5252. No amendments to NAAQS-setting procedures.

Administration. The Administration would maintain the basic concept of he health-based primary standards in the Act. Cost-benefit analysis should ot be included as statutory criteria in setting these standards, but standards should be based on sound scientific data demonstrating where air quality represents real health risks.

Secondary standards would continue to be set by the Federal EPA.

DEADLINE FOR ATTAINMENT OF NAAQS

At present, the CAA provides that the primary NAAQS shall be achieved by Dec. 31, 1982; except if an air quality control region cannot attain the primary ambient air quality standards for ozone or carbon monoxide by then, the deadline may be extended to Dec. 31, 1987. To qualify for an extension, additional pollution abatement measures, such as vehicle inspection and maintenance programs, are required.

National Commission on Air Quality. The NCAQ would remove the 1982/1987 deadlines and substitute a requirement that each State develop a plan to meet NAAQS "as expeditiously as practicable."

Each State would have to set a deadline for when it intends to meet NAAQS, but that date would not be reviewable or Federally enforceable. Every three years EPA and the State would review the plan and the deadline. EPA could require the adoption of "reasonably available control technology in states ot meeting air quality standards and failing to require that technology or quivalent measures."

H.R. 3471. This bill would require existing NAAQS to be attained "as expeditiously as practicable, (but no later than December 31, 1990)."

H.R. 5252. Permits case-by-case extensions of the 1982 attainment date to 1987 for any of the criteria pollutants. States can be granted extensions if attainment is not possible and if they do not modify State plans in any way to impede reasonable further progress. An additional extension of up to 6 years could be granted if reasonable progress has been made and the 1987 date is impossible to achieve.

H.R. 5555. Permits case-by-case extensions of the 1982 deadline for attainment of particulate and sulfur dioxide standards for up to 3 years, and for attainment of nitrogen oxides for up to 5 years. The 1987 deadline for carbon monoxide and ozone would not be changed.

Stafford Amendments. Provides that the deadline for any primary ambient air quality standard can be extended to December 1984 if State certifies earlier attainment is not possible. Under certain conditions the SO2, NOx, and particulate deadline could be further extended to December 1985 and the CO and ozone deadlines to 1987. If a State cannot meet the 1987 deadline for CO and ozone because of exceptionally difficult conditions, provision is made for a further extension to 1992.

Administration. The Administration principle says that deadlines for achieving primary air quality standards should be adjusted to reflect realities in particular areas.

TECHNOLOGY-BASED STANDARDS--NSPS/BACT/LAER

The CAA sets a series of technology-based standards for new or modified sources of air pollution. These standards include: (1) New Source Performance Standards (NSPS), which are EPA-set generic standards for categories of industries; they represent the best technology of continuous emissions control that, taking costs into account, the Administrator finds adequately demonstrated. (2) Best Available Control Technology (BACT), which is determined by the States on a case-by-case basis and is imposed on sources in "prevention of significant deterioration" (PSD) areas and on new sources for which no NSPS has been set. (3) Lowest Achievable Emission Rates (LAER), which are determined by States and imposed on sources in "nonattainment" areas. BACT and LAER may be more stringent than NSPS, but not less so. The paperwork associated with the case-by-case determinations of BACT and LAER, and the fact that they often differ little from NSPS, have been frequent criticisms of the Act.

In addition, the law specifies in its definition of NSPS that emissions from fossil fuel fired stationary sources must achieve a "percentage reduction" from the emissions that would have occurred from those sources if the fuel had been burned straight from the mine. This requirement means that a source cannot meet its sulfur oxides emission limitation simply by burning low-sulfur coal. Instead, whatever the sulfur content of the fuel, the standard requires that the emissions be reduced by some proportion.

National Commission on Air Quality.

The NCAQ recommended that:

-- the "new source performance standards program should be retained" (including the percentage reduction requirement);

- BACT for PSD areas be retained (except that smaller facilities could use NSPS); and
- LAER be eliminated and BACT substituted (except for small facilities which would meet the NSPS standard).

In effect, the three technology standards would be reduced to two -- NSPS and BACT -- and the technology requirements for sources in PSD and nonattainment areas would be made identical.

H.R. 3471. This bill would eliminate the BACT and LAER requirements and substitute NSPS requirements for sources in both PSD and nonattainment areas. Only sources for which no NSPS had been set would go through a case-by-case BACT review. Thus the three standards would be reduced to one for all sources for which a NSPS had been set.

In addition, the bill would repeal the provisions of the CAA requiring a "percentage reduction" of emissions from fossil fuel fired stationary sources.

H.R. 5252. Like H.R. 3471, H.R. 5252 eliminates separate BACT and LAER standards, making them equivalent to NSPS requirements where such requirements have been set. States may require more stringent stationary source controls if they choose, however.

Percentage reduction requirements would be continued for utilities but ould not be applied to industrial boilers.

H.R. 5555. Retains current provisions; spells out the schedule for revising promulgating NSPS.

Stafford Amendment. This Senate proposal wuld retain NSPS and BACT, and equate LAER with BACT, with minor ualifications.

Administration. The Administration says that except for needs to protect pristine areas like national parks, protection should be based on uniform technology requirements for pollution control.

In addition, pollution control standards for new coal-fired plants should be based on uniform emissions standards, rather than "percentage reduction," and environmental protection should be the criterion.

10-YEAR GRANDFATHER

The Clean Water Act includes a "grandfather" provision providing that once a new source is in compliance with applicable requirements, it shall not be subjected to more stringent requirements for 10 years or the amoritization period, whichever is less. The CAA does not include such a provision.

National Commission on Air Quality. The NCAQ recommended that a 10-year randfather provision be added to the CAA.

H.R. 3471, H.R. 5252, H.R. 5555 and the Stafford Amendment. All three bills and the Stafford proposal contain a 10-year grandfather provision, differing somewhat in the details of what sources would be eligible.

AZARDOUS AIR POLLUTANTS

The CAA provides for national emissions standards for hazardous air pollutants (NESHAPs) for which NAAQS are not appropriate. Relatively few NESHAPS have been issued, however, and often these have been controversial. Issues debated include whether the statute's provisions are unworkable, whether EPA has been lax in implementing its provisions, or, alternatively, whether EPA has been too stringent and too inflexible in its approach.

National Commission on Air Quality. The NCAQ recommended that EPA accelerate its program of identifying hazardous air pollutants and of determining whether they should be regulated. It further recommended that Congress investigate how to speed up the process, and in addition recommended that EPA be authorized to require immediate implementation of economical, readily available controls and set technology-based standards.

H.R. 3471. This bill would require that the Clean Air Scientific Advisory Committee review the evidence upon which a hazardous emission was proposed to be listed for regulation.

H.R. 5252. No change.

H.R. 5555. This bill proposes significant changes in the NESHAPs process. t would require EPA to list 37 specific air pollutants as hazardous unless he Administrator finds they are not. New or modified sources emitting significant amounts of listed hazardous pollutants would have to install controls to protect the public health with an adequate margin of safety, or to meet best available control technology as defined for nonattainment pollutants. The Administrator would set minimum emission standards for categories of sources emitting significant amounts of toxic air pollutants.

Stafford Amendment. This proposal would require EPA to determine in three years whether 37 specific chemicals (the same referred to in H.R. 5555) are hazardous, and to list them unless the Administrator finds they are not. Emission standards to protect the public health with an adequate margin of safety would be required; if such standard is technologically or economically impracticable, then a stringent technology standard could be set.

Administration. The Administration's principle says that a more effective hazardous pollutant program should be established to allow, for the first time, efficient control of the serious health hazards posed by airborne toxic pollutants.

PREVENTION OF SIGNIFICANT DETERIORATION

The CAA provides for the "prevention of significant deterioration" (PSD) of air quality in areas where the air is cleaner than required by the NAAQS. t present, PSD applies only to particulates and sulfur dioxide, but the CAA rovides for the future PSD regulation of other criteria pollutants. The Act regulates PSD by requiring such areas to be designated into three classes and specifying increments of pollution that can be emitted into each, ranging from very little (Class I) up to essentially the secondary NAAQS (Class III). Major new and modified sources must undergo preconstruction review and obtain a permit to ensure emissions will not exceed the area's increment. . Sources subject to review are determined by their potential to emit. Major issues include the complexity of the requirement, the delays it may cause, and the possibility it would foreclose construction of needed energy facilities.

National Commission on Air Quality. The NCAQ made numerous recommendations for simplifying and reducing the impacts of the PSD process. These include:

-- decreasing the number of modified facilities that would be subject to PSD review by raising the level of emissions triggering review;

-- making discretionary the requirement for one-year's monitoring during preconstruction review;

-- retaining BACT, but allowing NSPS for smaller facilities;

-- revising the PSD classes as follows: Class III would be eliminated, and only limited areas would be included in Class II (those which cannot be redesignated as Class III under the current Act -- e.g., large national monuments--and those which States or Indian tribes designate). Thus lands classified for PSD regulations would be limited to "special" areas.
Short-term Class II increments would no longer be tracked, although major sources subject to PSD review would have to demonstrate they would exceed neither the short-term increments nor the annual increment. The existing Class I increment system would be retained, with additional authority for Federal land managers in Class I areas to monitor for effects of new pollution sources on air quality.

-- retaining the current visibility protection requirements, and adding coal surface mining to the sources subject to visibility standards.

H.R. 3471. This bill would implement some of the NCAQ's PSD recommendations, such as making discretionary the monitoring required for preconstruction review, but in many cases it would go further in the effort to reduce paperwork and to ease the burden of the PSD program. The bill proposes:

-- raising the level at which emissions would trigger PSD review of modified sources even higher than recommended by NCAQ;

-- equating BACT with NSPS, as previously described;

-- eliminating most increments in a two-Class PSD system (retain Class I, but eliminate the short-term increments; classify all other areas Class II and make the upper level of allowable pollution equal to NAAQS);

-- adding a provision allowing "enforceable emission offset credits or other enforceable alternative control measures" which result in net emissions being no higher than if the source itself met emission requirements;

-- Repealing the requirement that PSD regulations for criteria pollutants other than sulfur dioxide and particulates contain specific measures at least as effective as the class-increment system; and

-- prohibiting visibility regulations until EPA submits a study to Congress on the causes and extent of visibility impairment.

H.R. 5252. The bill would significantly change PSD requirements by equating BACT with NSPS, as previously described, by eliminating the Class II and Class III increments, and by eliminating the exceedance provision of one time per year for Class I increments. The bill does not amend the visibility regulation section. On extending PSD provisions to the other criteria pollutants, H.R. 5252 repeals the requirement that PSD regulations for criteria pollutants other than sulfur dioxide and particulates contain specific measures at least as effective as the class increment system.

H.R. 5555. This bill would redefine emissions increases so as to trigger fewer PSD reviews, would exempt preconstruction review of modified or replacement projects having no net increase in emissions, would make preapplication monitoring discretionary, would specify EPA application review time, and would simplify the State-Federal review process. Increments in Class III areas would be repealed, and procedures for redesignating Class II o Class III would be simplified. BACT would be retained.

Stafford Amendment. The only change to the PSD provision of the CAA would be to permit a Governor to provide that emissions of soil uncontaminated by industrial activities will not be included in calculations of increment consumption.

Administration. The Administration's principle is that while the current program for the prevention of significant air quality deterioration should be maintained for the protection of park and wilderness areas (Class I), in other areas, protection should be based on uniform technology requirements for pollution control (presumably NSPS).

NONATTAINMENT

The CAA establishes additional requirements for air pollution control in nonattainment areas -- those in which one or more NAAQS is not yet attained. These requirements include annual incremental progress through the imposition on existing sources of reasonably available control technology; preconstruction review of major new or modified sources and imposition of LAER; and, for areas seeking a deadline extended to 1987, establishment of vehicle inspection and maintenance programs. A critical issue has been the extent to which the stringency of these requirements may prevent the construction of new sources in nonattainment areas; new sources typically mit less pollutants than existing facilities that they may replace.

National Commission on Air Quality The NCAQ would repeal the 1982/1987 deadlines and substitute a process in which each State sets its own, nonreviewable, deadline; and every three years EPA and the State would assess progress towards achievement of NAAQS (see the discussion above under DEADLINES). LAER would be replaced by NSPS, as previously noted. In addition, the NCAQ recommended

-- requiring vehicle inspection and maintenance only in urban areas with populations greater than 500,000 and where peak 1981 air pollution levels exceed ozone and CO standards by 50%;

-- making discretionary (instead of mandatory) transportation control measures in ozone and CO plan revisions;

-- replacing the present system of sanctions through withholding grants in areas not meeting the Act's requirements by a graduated system of sanctions, with EPA having discretion in their imposition; and

-- allowing new sources in nonattainment areas to pay a fee in lieu of obtaining an offset, with the fee to pay for reductions in other emissions of the same pollutant.

H.R. 3471. Although this bill would extend the date for achieving NAAQS (to December 31, 1990) instead of eliminating the deadline as recommended by NCAQ, it generally goes further in reducing requirements. The bill proposes

-- repealing LAER, as described previously;

-- repealing the requirement that State Implementation Plans be approved before new or modified sources can be constructed in nonattainment areas;

-- specifying that cost be considered in determining "reasonably available control technology" required on existing sources in nonattainment areas;

-- repealing the sanctions of withholding various Federal grants (sewer, highway) for failure to achieve NAAQS or to prepare an approved plan; and

-- making discretionary the requirement that transportation controls be imposed, and permitting transportation controls and vehicle inspection and maintenance programs in approved implementation plans to be dropped by the governor of a State without any penalty.

H.R. 5252. Besides providing for deadline extensions and the equating of LAER with NSPS, as previously noted, the bill adds flexibility and discretion -- for example, in the imposition of construction bans and of auto inspection and maintenance requirements. The Federal sanction of withholding sewer and highway grants is repealed.

H.R. 5555. Generally, this bill retains existing nonattainment requirements. As noted, it establishes procedure for case-by-case extensions of deadlines for SO2, TSP, and NOx. It provides for an exception to the prohibition of new construction in nonattainment areas for which an SIP is not approved. It provides for a "bubble concept."

Stafford Amendment. As discussed above, this proposal relates LAER to BACT and provides for deadline extensions, under certain conditions, to 1985 or SO2, NOx, and particulates, and to 1992 for ozone and CO. Also, it limits the imposition of the construction moratorium sanction to areas failing to meet the applicable deadline, or failing to require offsets or their equivalent, or failing to implement an inspection and maintenance program.

Administration. While none of the principles specifically refer to nonattainment areas, three of them are relevant: the adjustment of deadlines to reflect realities in particular areas, the basing of protection on uniform technology requirements (presumably replacing LAER with NSPS), and the general exhortation that statutes and regulations should be reasonable and should be related to the economic and physical realities of the particular areas involved.

STATE IMPLEMENTATION PLANS

The mechanism for carrying out the achievement of NAAQS and the PSD and nonattainment programs is the State Implementation Plan (SIP). The CAA is quite specific about what a SIP must contain and how it is to be approved. Many of the procedures and requirements have been critized as ineffective, unnecessarily complex, or requiring duplicative efforts of Federal and State governments.

National Commission on Air Quality. The NCAQ recommended that EPA, together with State and local agencies, should submit to Congress "an analysis of whether all current state implementation plan requirements should continue to be subject to Federal rulemaking and enforceability. Congress should then consider appropriate revisions...."

Specific NCAQ recommendations include

- -- where State requirements are consistent with Federal requirements for notification and hearing procedures, requiring EPA to base its assessment of a SIP revision on the State hearing record and making EPA's failure to act on a SIP revision within 90 days automatic approval (no deadline under current law);
- -- allowing States that establish a permit program to do so in a generic regulation; and
- -- limiting EPA's review of permits issued under generic regulations, and making failure to act within 90 days constitute automatic approval.

H.R. 3471 This bill not only contains provisions similar to the specific NCAQ ones, but also adds several others designed to give the States greater authority and flexibility:

- -- extending from 9 months to 3 years the time a State may develop a SIP for a new pollutant;

-- permitting the State in emergencies to suspend SIP requirements for 14 days without EPA approval;

-- allowing the governor of a State to delete transportation control and vehicle inspection and maintenance programs from approved SIPs without penalty; and

-- establishing a new State permitting program.

H.R. 5252. The bill adds a new section to provide administrative flexibility to speed up SIP revisions. Several basic changes are provided:

-- extending from 9 months to a "reasonable time as determined by the Administrator (but not to exceed two years)" the time a State may develop an SIP for a new pollutant;

-- establishment of procedures to ensure expeditious EPA review of a SIP change, by setting specific deadlines and requiring the EPA Administrator to act within them; failure of EPA to act would constitute approval;

-- provision for "automatic" approval of "non-controversial revisions" if a State follows EPA procedures and no "non-frivolous objections" are made;

-- permitting regional administrators to approve/disapprove some SIP changes; and

-- permitting States to issue variances for up to 6 months in emergencies.

H.R. 5555. This bill requires EPA to approve or deny SIP revisions in 4 months (does not provide that failure of EPA to act in 4 months constitutes automatic approval, however). Establishes a "fast track" approval system for 10 types of plan revisions if no objection to the revision is filed within 30 days.

Stafford Amendment. Provides for automatic approval of SIP revisions byl EPA if the Administrator has not acted to disapprove the revision within 120 days of submission, unless an objection has been filed at the State or Federal level, in which case the Administration must explicitly respond.

Administration. The Administration's principle is that States should be accorded a full partnership in implementing the nation's standards, and the Federal Government should monitor State achievement of national health and welfare standards.

MOBILE SOURCES

The Clean Air Act establishes emission limitations for automobiles and other mobile sources. The current limitations for lightweight vehicles require 90% reduction in hydrocarbons (HC) and carbon monoxide (CO) as compared to precontrol vehicles, and a 75% reduction in nitrogen oxides

(NOx). Current (1981 model year) standards are: HC - 41 grams/mile; CO - 3.4 grams/mile (some waivers in effect); and NOx - 1 gram/mile (diesel waivers in effect). For details, see IB81135 -- "Air Pollution: Mobile Source Emission Controls."

National Commission on Air Quality. The NCAQ recommended that most existing mobile source standards be retained. The only significant modification would be increasing the automobile carbon monoxide standard from 3.4 grams per mile to 7.0 grams per mile through 1986, and giving EPA discretion on the appropriate level between 3.4 and 7.0 grams after that date.

The NCAQ recommended that the "high altitude" provisions of the Act be continued with revisions, including extending high altitude standards to light trucks.

H.R. 4400. The Traxler bill is a comprehensive revision of the mobile source provisions of the CAA (Title II). Major effects of its amendments are the easing of emissions standards, providing more opportunities for innovative technology waivers, ensuring manufacturers' leadtime to meet standards, and establishing a two-car strategy for meeting standards at high altitudes. Strategically, the key change is changing the basis of the emissions standards from a percentage reduction in auto emissions from the 1969 base year to an emission limitation related to achieving NAAQS, with the statutory standards being the most stringent level mandated.

-- Standards: hydrocarbons - change present 0.41 grams/mile to 0.39, but exclude methane emissions from consideration; carbon monoxide - raise present 3.4 grams/mile (with some waivers possible for 1981-1982 models) to 7.0; nitrogen oxides - raise present 1.0 grams/mile (with some waivers for innovative technology and diesels available to 1985) to 2.0.

-- Waivers: expands the opportunities for waivers, providing that upon petition of any manufacturer, the Administration "shall" issue a waiver of any standard for up to four years as necessary for use of innovative technology (provided public health would not be endangered). The waiver could apply to as many as 500,000 vehicles or engines of each such model.

-- Leadtime: adds a provision giving a manufacturer a three-year leadtime between issuance of a standard and compliance date for autos and light trucks and a four-year leadtime for heavy duty vehicles.

-- High altitude requirements: prohibits any requirement that special pollution control technologies on cars certified for high altitude areas be placed on all cars; and eases the level of emissions that high-altitude cars must meet (by making the standard a percentage reduction of what the high-altitude emission would be rather than the level that a low-altitude car would achieve).

H.R. 5252. This bill contains several provisions similar to H.R. 4400.

-- Standards: hydrocarbons - no change; carbon monoxide - 7.0 grams/mile; nitrogen oxide - 2.0 grams/mile. These standards would be in effect for model years 1982 through 1986; for succeeding years EPA could adjust the standards up or down, except they could not be more stringent than the 1981 standards.

-- Waivers: waivers for any standard shall be issued if necessary for innovative technology, for not more than 500,000 vehicles per manufacturer for four years.

-- Leadtime: same as H.R. 4400.

-- High altitude requirements: separate standards maintained, but continuing the present proportional reduction.

H.R. 5555. Unlike H.R. 5252 and H.R. 4400, this bill would continue virtually all mobile source emission standards as in present law. In addition, several standards proposed by EPA but not yet finalized would be codified, and EPA forbidden to relax them. Deadlines for the NOx standard for diesel autos and for the high-altitude requirement would be extended slightly.

Stafford Amendment. This proposal retains most existing mobile source equirements. For autos, the standard for NOx would be set at 1.5 grams per ile for model years 1983 and 1984; and a particulate standard of 0.2 grams per mile would begin with model year 1986 (with certain waivers possible for two model years). For light trucks and heavy-duty vehicles, the proposal would codify certain standards, prohibiting the EPA Administrator from relaxing them. When diesel-powered vehicles comprise 10% of total annual sales of light-duty vehicles and light duty trucks, EPA is required to regulate the sulfur content of diesel fuel to less than 0.05% by weight. The high altitude provision of the CAA would not be amended.

Administration. The Administration's principle concerning mobile source controls says that automobile standards should be adjusted to more reasonable levels, as suggested by the NCAQ -- with the note that the limit for nitrogen oxide could be raised to a level slightly higher than that suggested by the NCAQ without affecting air quality goals.

INDOOR AIR POLLUTION

The CAA does not provide for the regulation of indoor air pollution.

National Commission on Air Quality. The NCAQ recommends statutory clarification of Federal jurisdictions over research, monitoring, and regulation of indoor air quality in non-industrial settings.

H.R. 5555. This bill requires EPA to report to Congress one year after nactment on indoor air pollution.

ATMOSPHERIC TRANSPORT

The interstate transport of air pollution has become an increasingly difficult issue, as some States gather evidence that their failure to achieve NAQS results from pollution emitted from beyond their borders. Also, long-range transport of pollutants is believed to contribute significantly to the "acid rain" problem.

National Commission on Air Quality. The NCAQ made several recommendations to strengthen the CAA with respect to interstate pollution. It recommended modifying sections 110(a)(2)(E) and 126 to provide additional authority for identifying and controlling interstate pollution; congressional consideration of regional secondary standards; expanded monitoring; and a "significant reduction in the current level of sulfur dioxide emissions in the Eastern United States."

H.R. 3471. This bill would change the present acid precipitation study program mandated in the Energy Security Act from 10 years to 5 years.

H.R. 5555. This bill addresses the issue in two major ways. First, it revises the procedures by which interstate air pollution problems are handled. Once a State petitions EPA for a funding on interstate pollution, EPA must respond within 60 days and must require the States involved to take appropriate action. Second, H.R. 5555 establishes an "acid deposition region" in the 31 States east of the Mississippi and requires reductions in sulfur dioxide emissions of 60 million tons within 10 years.

Stafford Amendment. This proposal, like H.R. 5555, attacks the acid rain issue from two directions. It makes emissions of any air pollutant that adversely affect the public health or welfare of another State a violation of the Act and requires installation of reasonably available control technology on sources found to be in violation. It caps emissions of sulfur dioxide and nitrogen oxides in the Eastern 31 States and requires a reduction of 10 million tons in sulfur oxide emissions to be achieved within 10 years. Procedures by which the reduction will be accomplished are spelled out.

Administration. The Administration's principle is that research on acid deposition should be accelerated.

For other bills concerning this issue, see IB80022 -- Acid Precipitation: A Serious and Growing Problem.

SUMMARY

In the House, H.R. 5252, supported primarily by industry and the Administration, and H.R. 5555, suported by environmental groups and others, appear to define the issue. As a general statement, the former eases some requirements and removes others, simplifies a number of administrative procedures, and provides additional flexibility for decisionmakers. According to sponsors, these changes will reduce compliance costs and streamline procedures without adversely impacting the Act's protection of health. The latter bill generally adds air protection requirements, makes relatively few changes to remove procedural requirements, and forbids EPA the discretion to make some decisions concerning mobile source standards. According to sponsors, these changes are necessary to ensure continued protection of health from air pollution and to deal with new issues such as "acid rain," while the most burdensome procedural requirements are eased.

It seems likely that H.R. 5252 and H.R. 5555 express two viewpoints that ill repeatedly conflict as the legislation is taken up in subcommittee, ommittee, and ultimately the floor of the House.

In the Senate, the process has not polarized into two substantially different bills. Markup was proceeding with the existing Act as the vehicle until the end of February, when Chairman Stafford introduced to the Committee his recommended amendments. The future pace and direction of the Committee's markup remain to be seen.

LEGISLATION

H.R. 3471 (Broyhill, et al.)

Amends the Clean Air Act to revise air pollution control standards and procedures. Authorizes appropriations to carry out such Act. Amends the Energy Security Act to revise acid precipitation research plan provisions. Introduced May 6, 1981; referred to House Committee on Energy and Commerce; referred to Subcommittee on Health and the Environment May 7, 1981.

H.R. 4400 (Traxler et al.)

Amends the Clean Air Act. Introduced Aug. 4, 1981; referred to Committee on Energy and Commerce.

H.R. 5252 (Luken et al.)

Amends the Clean Air Act. Introduced Dec. 16, 1981; referred to Committee on Energy and Commerce.

H.R. 5555 (Waxman)

Amends Clean Air Act (see discussions above). Introduced Feb. 22, 1982; referred to Committee on Energy and Commerce.

REPORTS AND CONGRESSIONAL DOCUMENTS

Luken, Thomas. Remarks in the House. H.R. 5252 -- The Clean Air Act Amendments of 1981. Congressional record daily ed. Sept. 16, 1981: H9921 - H9925.

U.S. National Commission on Air Quality. To breath clean air. Washington, U.S. Govt. Print. Off., 1981. 356 p.

CHRONOLOGY OF EVENTS

08/05/81 -- EPA Administrator Anne Gorsuch announced the Administration's 11 principles to guide amendments to the CAA.

03/01/81 -- National Commission on Air Quality issued its report, To Breath Clean Air.

[Staff Summary of the Health Effects Preserves follows:]

Mr. WALKER. Thank you, Mr. Chairman.

Mr. GORE. Let me summarize that staff study, which is, in itself, a summary, and ask you gentlemen to comment on it.

There is a relationship between the expected market impact of diesel technology, and our reaction to the uncertainty surrounding the health effects.

In other words, the current resolution of this uncertainty is to say, if the market impact is not going to be very significant, then we can tolerate a greater uncertainty.

On the other hand, if the market impact is going to grow and the exposure is going to be more significant, then we have to view the uncertainty surrounding the health effects in a somewhat different light, and be more concerned about them.

If I could try to describe the parameters of that uncertainty, with respect to whole exhaust, I am going to go through two categories, the effects of whole exhaust and the effects of extracts.

Where whole exhaust is concerned, the studies have been inconclusive with respect to carcinogenicity.

They have been proven in part with respect to mutagenicity.

They have been inconclusive with respect to systemic pulmonary effects, but proven, in part, in mammalian cell bacteria on animal systems. They have been proven, in part, with respect to optic effects.

Now, where diesel extracts are concerned, carcinogenicity has been proven.

Where extracts are concerned, mutagenicity has been proven, and systemic pulmonary effects have been proven, in part, as have optic effects.

Now, there is a raging debate about the relationship between the extracts and whole exhaust exposure on both sides of the debate. There are arguments made about that relationship.

Suffice it to say that that represents a lot of uncertainty, but the weight of the evidence points toward increased concern as the exposure to the population increases.

Is that a fair summary? Do any of the three of you object to the way that is stated?

Mr. WALSH. Mr. Chairman, I think that is a fair summary.

Mr. GORE. All right. Let me talk, then, for a minute about the economic penetration, market penetration, and at this point, I would like to take you up, Mr. Jouppi, on your very kind offer to provide for the subcommittee a rather extensive exhibit encompassing what you described as the fresh viewpoints and data from investment research analysts to deal with the capital investment, the planning and cash-flow matters of the auto-related companies.

I appreciate very much your offer to compile such an exhibit, and we would like to hold the record open to include that when you compile it.

Now, you have projected, Mr. Jouppi, that diesel-powered passenger vehicles will penetrate up to about 20 percent of the passenger fleet by 1990.

Is that reading tea leaves, or is that something you feel comfortable with?

What kind of weight should we assign to that prediction?

Mr. JOUPPI. I would think that I feel comfortable with it.

I don't think it is tea leaves.

We have advancing technologies in many areas, and the present gasoline-powered vehicle has a ways to go yet, and by 1990, I would expect that there would still be an opportunity, or there would be an opportunity, for still another type of motive power that would be in sight then, and I am thinking here, and I do have an error, or a wrong word in my written testimony which I did not catch, and that is, out into the next century, I will expect that we will have not diesel power, not gasoline power, so much as we might have fusion power, nuclear power of another type.

Mr. GORE. Electric vehicles?

Mr. JOUPPI. That would be one of the processes probably, but we cannot consider that now because for the next 20 years or so we are going to have the kinds of vehicles that are in place and moving.

I would place the 20 percent figure of the 1990 production as a reasonable number and certainly not exact.

Mr. GORE. What effect has the recent oil glut had on your view of this market? I noticed in yesterday's Wall Street Journal a discussion of the dilemma of the energy forecasters and reference made to this subcommittee last year on that subject, but insofar as it is possible to discern the impact of the oil glut, how would you factor that in?

Mr. JOUPPI. The oil glut would tend to change the composition of the automobile market and also the truck market, moving more toward gasoline and away from diesel.

Mr. GORE. What about the financial sluggishness of the auto industry? What effect will that have on diesel penetration?

Mr. JOUPPI. Actually, the financial problem of the automobile industry, we all know they are very grave, and one reason that they are grave is that there remains the uncertainty, and I would like to commend this committee in the effort that it is making to provide clear objectives.

We have around us here something that reminds me that when the technical scientific job to get to the Moon, the Moon was not going to change. It would stay right where it was, and we would have to get there, and the scientific effort the automotive industry needs to do is somewhat of the same order, so whatever is done at whatever stage is certainly commendable as far as, or so long as, it will stick.

Mr. Doniger mentioned that you can go ahead and establish, spend your money. He didn't say it that way. He said, you can spend your money and maybe you will have a use for what you end up with, and maybe you will not.

That, I think, is, from a financial viewpoint, a factor which in very simple language makes the stocks of the auto-related company less valuable than they might be if there was a very firm standard.

Mr. DONIGER. Looking at the past record of the game of chicken between the auto industry, on the one hand, and the EPA and Congress, on the other hand, no one sophisticated enough to understand all the other complex things that are involved in evaluating the investment potential of a company, could say the auto companies have been overmatched in the last 10 years by the Government and Congress.

The auto industry faced 1975 standards for gasoline cars. It got them postponed to, and met them in, 1981. No one, as far as I know, went off selling auto stocks in the spring of 1973 on the possibility that the auto emission standards of 1975 could not be met or would not be changed.

The question is whether the auto companies are going to have total control over the timetable on which they have to make changes that are related to public health and the environment, or whether that responsibility is going to be shared by the people through the Congress and the EPA.

It seems to me that people everywhere are sophisticated enough to know that this standard is not immutable. The fact it is being re-considered now means it is very mutable. No one is going to be driving the auto industry out of business, in order to keep a standard that it is clear that it can't be met. But at this point it is not clear it can't be met. So the standard should be kept until you get closer to the deadline and can see what the pressure of the standard will cause the auto companies to do.

Mr. GORE. Would you consider it a fair statement, Mr. Jouppi, to say that the companies are less willing to absorb the costs of an emission control device than they are to absorb the cost of something that enhances the marketability of an auto?

Mr. JOUPPI. The automobile company is made up of individuals, and there are many individuals in the car companies, in the engineering staffs, and so forth, who are every bit as concerned about clean air, and so forth, as the scientists on the outside who specialize in that; but I would say that a marketable item at this particular time would be more attractive than would be something that had not just been sold, put it that way, to the general public.

Mr. GORE. Mr. Doniger, has the NRDC accepted any projections on future diesel penetration? Do you support the 25 percent by 1990 figure in your testimony?

Mr. DONIGER. Yes, certainly I support the figure in my testimony. The figure that I was using was the figure that EPA used, based on auto industry information and analysis of it.

That was when the EPA set the standards back in 1980, and I said in my oral testimony that maybe now it would be a little lower.

Mr. GORE. The auto industry uses figures much lower than that now. If yours is indirectly based on theirs, then you would make a similar adjustment in your estimate?

Mr. DONIGER. I think that is correct, although I am very aware of how information from the auto industry in a regulatory context may not alway be what it seems. The question of penetration may be of some importance to how fast to go with these standards. There are incentives to play down the growth in diesel.

It has not come on quite as fast as is projected, but the whole auto industry has been in, how should we say it, an unusual situation for the last couple of years. It seems to us to be prudent to nip the problem as early as you can in the bud.

Mr. GORE. Mr. Jouppi, is there any such thing as a fuel price elasticity figure for diesel penetration?

Mr. Jouppi. I don't know of a specific number, but we do know that as gasoline prices came down and as diesel price actually went above that of gasoline, that diesel sales fell off.

Mr. Gore. Nevertheless, diesel sales have continued to increase at a percentage rate faster than that of gasoline-powered cars; correct?

Mr. Jouppi. That is correct. However, in the last 3, 4 months, there has been a change in that there was a shortage of diesels during the period when gasoline prices were up $1.30, $1.40, and now there is not a shortage, except that here and there where the manufacturing schedules may not have moved up to the full market ever.

Mr. Gore. The increase, the percentage increases, are, in fact, leveling off from the latest figures.

Mr. Walsh. Could I make a comment?

It seems to me in the last 10 years we have gone through several significant energy perturbations.

Mr. Gore. I have noticed that.

Mr. Walsh. We had no push toward diesels until the 1973-74 energy crunch hit. We started to get an accelerating effort on the part of the manufacturers, I think, largely in response to the corporate average fuel economy requirements in the mid to late 1970's, and a rapidly accelerated market demand right after the Iranian energy crisis of 1979-80.

Right now, we are witnessing a situation where real energy prices are going down dramatically, certainly more so in the case of gasoline rather than diesel, but I would raise questions as to whether we should expect that to be a long-term phenomena, and I mean over the next decade, not a year or two, and I would urge you and this committee to look at it in that kind of a timeframe.

Mr. Gore. This committee has looked at that question very closely, and we found that whatever the current trend in the marketplace is, tends to be projected out into the future, and, in fact, there are violent discontinuities in the energy marketplace, and it is reasonable to suppose that within the next 5 years, the likelihood is extremely high that we will once again have an episode of dramatically increased fuel prices, and that the current benign trend that people tend to project on out is likely to be disruptive.

I think this whole business of trying to project the penetration is admittedly an uncertain exercise.

Well, I think that—well, let me ask one more question of Mr. Walsh. As I am sure you are aware, the EPA is presently considering this petition, and reference has been made to delay the 1985 particulate standard. Do you think that the state-of-the-art in emission control technology justifies that such a change occur? I take it your answer is no.

Mr. Walsh. I think it is premature, is my answer. I think we should wait at least into the early part of next year, not 6 months before the cars have to be on the road, but we should wait until next year.

Mr. Gore. The most recent report by the National Academy tends to support a delay.

Mr. Walsh. Yes, it does, and you will have Professor Sawyer talking a little later today, and he is indicating perhaps 1986 or

1987 would be a better timeframe, but, as I said in my statement, I am encouraged in some areas by the dramatic progress that has been made, even without traps, in terms of bringing the particulate levels down, because I know the manufacturers have stated in public forums that a lot of work is going on right now, and I would not be inclined to do anything to put a chill on that work.

I would like to see that work go forward at least another year, and that is still adequate time to take stock of where we should be in 1985.

Mr. GORE. Do you have other questions?

Mr. VOLKMER. I would like to ask a few more.

Mr. GORE. Sure.

Mr. VOLKMER. Mr. Jouppi, what sort of ripple effect would cancellation of light duty diesel engines in 1985 have on supplier firms, and I would like to know in what geographic area of the country are the chief diesel suppliers?

Mr. JOUPPI. Many of the diesels, of course, are imported. The diesel engines are not manufactured in the United States not all of them.

There certainly is a need to develop a pure diesel engine technology which does not exist now fully for the vast majority of our industry, where gasoline engine technology is moving forward ahead of diesel.

The most specific effect would be if we did not permit small diesels, that we would be negating, we would be making useless, a fair amount of advanced technology toward development of specific diesel engines for small vehicles.

Mr. VOLKMER. Are the other American automobile manufacturers like Ford, Chrysler and American Motors going into diesels, like GM?

Mr. JOUPPI. No.

Mr. VOLKMER. Do you see any future; that they may go into that in the future?

Mr. JOUPPI. Sir, I think that they would be looking in two directions.

In the Ford instance, I think they would be looking across town to General Motors to see what they are doing and, very importantly, they would be looking to Washington to see what the ultimate requirements and standard is going to be.

There is this matter of making all the choices for capital investment, and there is a shortage of capital in the automobile industry. There is a feeling that maybe I won't make it myself. I may need it. I will buy it. I will then make a salesman's profit rather than a manufacturer's profit.

That is kind of an attitude that exists in Chrysler, American Motors, Ford Motor Co.

Mr. VOLKMER. They could do something similar to what Chrysler did with a little Volkswagen engine for their Horizons that just came out, and this would be technology that would be in place in other countries; that we would just purchase the end product?

Mr. JOUPPI. That is certainly a consideration.

Mr. VOLKMER. That is some concern, too.

Mr. WALKER. Isn't it true that Chrysler, particularly, is looking into diesel, that they have gone, I noted, to the idea of putting them in the Peugot, but aren't they also exploring with Perkins to perhaps develop jointly a diesel engine to be used in their automobile?

Mr. JOUPPI. That is true.

What I think we are going to see here is a standardization of engines; that engines will go across borders much more freely than they did when we in the United States had big engines and everybody else had small engines. I look for the standardization, and where the engine will be made is partly a regulatory matter involving tariffs, and so forth.

Mr. WALKER. I thank the gentleman for yielding.

Mr. VOLKMER. One more question: What kind of impact would there be on the financial condition of the automobile industry? What do you expect if light-duty diesel engines were eliminated by 1985—all we had was gasoline?

Mr. JOUPPI. I really don't have a view on that.

I am an analyst of what is happening, and since I do not feel that it will, that we will have an elimination, I really don't have a good view on what it would cost if you did eliminate them.

Mr. VOLKMER. All right.

Mr. Walsh, I would like to—I was always told an attorney should not ask a leading question you don't know the answer to, but I am curious to see your answer, anyway.

Back when you helped write the rule on the particulate, and now, again, you are firm in your opinion that by 1985 model year, 1984, that there will be technology available to reduce particulates, that we won't have to, any longer, have diesel engines in this country? Is that a correct summary?

Mr. WALSH. Not quite.

I am as firm today and perhaps more firm today than I was then that from a health and welfare standpoint, we need the particulate control.

I am encouraged by the progress that has been made. Whether or not it ultimately will be there for the 1985 model, it is a little premature to decide that.

We should let the work proceed for another year, and then look at that question.

Would also add one point to the question you asked the previous witness, or to Mr. Jouppi, that there is another contender, as it were,with the diesel engine that has slipped a little to the sideburner, but I think work is still going on with regard to the Proco engine at Ford Motor Co.

Whether or not Ford goes fully into diesel or continues its work on Proco will depend on what the Government does, because the Proco is in the same ballpark from an engineering efficiency standpoint as to diesel, but has a real advantage on the particulate side of things without any additional addon controls, and Ford may be, in fact, looking at Government and trying to decide which way it should be, partly in terms of what we do with particulate control.

Mr. VOLKMER. Well, then basically, to get back to the original statement, you are not 100 percent sure then that we have the technology available at the present time in order to meet this standard for the 1985 model?

Mr. **Walsh**. Today we do not have the technology to meet it on every model, but I am encouraged that we could have that technology for the 1985 model.

Mr. **Volkmer**. Will we have it at least a year before, or are we going to wait until the model goes on line and everything is structured and all the parts, you know, that have to be in place—we cannot wait for that.

Mr. **Walsh**. No. I think we owe it to the manufacturers to not wait until 2 months before the cars are supposed to be in the showrooms. I do not think that is fair to them. I do feel that waiting until the spring of 1983 is not an unreasonable time. That is the same timeframe in which the final decisions were made on catalyst for the 1975 cars, and from my perspective at least I thought that worked out satisfactorily, and I think it could work out the same here. If we are in a position a year from now to say the technology is really not here, then to delay the standard for a year or 2 years I think would be a prudent course of action. To delay it now I think is premature.

Mr. **Volkmer**. Thank you very much.

Mr. **Gore**. You mentioned the impending choice of Ford, but Ford has canceled the Proco program.

Mr. **Walsh**. My understanding was that they canceled the initial program, which was dealing with the large engine, because they have concluded that large engines were not within their future market plans, and I think it is a good decision. But I am not under the understanding, and I could be wrong, that they have canceled it across the board.

Mr. **Gore**. Our understanding is that they are continuing with only theoretical studies, but——

Mr. **Walsh**. That could be.

Mr. **Gore**. We can clarify for the record. I want to thank all of you for getting us off to a good start today. Thank you for excellent testimony.

Mr. **Gore**. Our second panel consists of Prof. Robert Sawyer from the department of mechanical engineering at the University of California, Berkeley, and Mr. John Blizard, executive director of the Association of Manufacturers of Emission Controls.

Gentlemen, if you would work your way up to the witness table. I would like to welcome both of you to the hearing today. Without objection, the entire text of your statements will be put into the record in full at this point. We invite you to proceed with the presentation of any or all of your statement as you see fit, and we would like to begin, Professor Sawyer, with you. Welcome, and please proceed.

STATEMENTS OF ROBERT SAWYER, DEPARTMENT OF MECHANICAL ENGINEERING, UNIVERSITY OF CALIFORNIA AT BERKELEY, AND JOHN BLIZARD, EXECUTIVE DIRECTOR, MANUFACTURERS OF EMISSION CONTROLS ASSOCIATION

Mr. **Sawyer**. Thank you very much, Mr. Chairman. It is a pleasure to be here. From the remarks of the previous speakers, it sounds as though I will be cast in the role of defender and apologist for the National Academy of Sciences study.

Mr. GORE. That is only one of the roles we have asked you to play.

Mr. SAWYER. I am Robert Sawyer, a professor of mechanical engineering at the University of California at Berkeley. I recently chaired the Diesel Technology Panel, part of the Diesel Impact Study Committee of the National Research Council, and contributed to the reports of both the panel and the overall committee. Currently I also serve as a member of the Research Committee of the Health Effects Institute. The remarks which I shall make today, although drawn in large part from the work and reports of the National Research Council Diesel Impact Study, represent my own appraisals and conclusions, and do not necessarily reflect the view either of the National Research Council or of the University of California. The three major reports of the Diesel Impacts Study Committee, to which you may wish to refer for additional details, are first, "Diesel Cars, Benefits, Risks, and Public Policy—Final Report of the Diesel Impacts Study Committee (1982)," second, "Health Effects of Exposure to Diesel Exhaust (1980)," and third, "Diesel Technology (1982)."

The diesel engine offers a substantial fuel economy advantage over current gasoline engines in light-duty passenger vehicle applications. The estimate of the Diesel Technology Panel was a 35-percent improvement. Primarily because of this fuel economy advantage, a penetration of as much as 25 percent of new car sales by 1990 seems reasonable. Most manufacturers who sell passenger vehicles in the United States now offer or plan to offer diesel engine options. The cost savings to the first owner, who must pay a premium for a diesel engine, is marginal. As the cost of diesel fuel continues to increase relative to that of gasoline, the cost savings will further erode. The motivation to purchase a diesel engine must also stem from a perception that high mileage is of itself a desirable attribute, that increased range is desirable, and/or that diesel fuel will be more available than gasoline during the next energy crisis. These real and perceived advantages must be weighed against the common, and generally accurate, observation that diesels are noisy, smelly, and dirty. Since manufacturers are likely to improve diesel engines in all of these respects, a continuing and increasing popularity is predictable.

Uncontrolled diesels emit about 30 to 50 times the mass of particulate of the catalyst-equipped gasoline engines which they will replace. The Environmental Protection Agency—mandated particulate emissions standards of 0.6 and 0.2 grams per mile are stated to be based upon the potential contribution of light-duty diesels to general urban ambient particulate levels. The carcinogens contained on diesel particulate are of concern, but the risk remains ill-defined, and no evidence exists which links airborne diesel particulate to human cancer. Research is progressing in this area. Nitroarmomatics, which only recently have been identified on diesel particulate and have been demonstrated to be potent carcinogens in rodents, add to this concern. The immediate impact of diesel exhaust will be a degradation of visibility and an increase in soiling in uban areas. To the credit of the diesel, its emissions of hydrocarbons and carbon monoxide will be lower than the gasoline engines which will be replaced.

The 0.6 gram per mile particulate emission standard has been met, as required, by the 1982 model passenger cars through modification of fuel injections systems at little or no marginal cost over 1981 models. In fact, in most cases certification emission levels are well below the 0.6 gram per mile standard. Meeting of the scheduled 1985 standard of 0.2 grams per mile will be more difficult. Meeting of this standard through additional improvements in fuel injection, combustion chamber design, and more sophisticated engine control—including exhaust gas recirculation—appears feasible except in larger vehicles. Particulate emissions increase with vehicle size, thus the larger vehicles will probably require exhaust treatment. The recently demonstrated oxidizing trap systems are currently the most promising approach. The availability of these systems for all of the larger vehicles by the mandated 1985 model year appears unlikely. The development of a reliable system to control the periodic oxidation or "burnoff" phase of operation is proving difficult. If engine improvements and control technology are actively pursued and diesel fuel quality maintained, further reduction of particulate emissions to 0.1 gram per mile or less is technologically feasible.

Mr. GORE. Professor, excuse me for interrupting. Those are the second bells of a vote an the floor, and we are going to recess for 10 minutes and then come back, go over and vote, and then come back. So with your indulgence, we will break off there.

[Recess.]

Mr. GORE. The subcommittee will come back to order.

We apologize for the delay, and we were hearing from you, Professor Sawyer. Incidentally, the subcommittee would like to express its special thanks to you for going to the trouble to fly on what they call the redeye to be a part of this hearing after having been on the east coast over the weekend, and then to fly back to this, and we appreciate it very much.

You were in the process of beginning your statement, and please proceed.

Mr. SAWYER. Yes. I was about to express comments on the tradeoff between oxides of nitrogen and the particulates. Let me pick up from there.

Early emissions control approaches have resulted in an apparent tradeoff between oxides of nitrogen and particulate control. Many vehicles now sold have received a waiver of the 1.0 gram per mile NOX standard to 1.5 grams per mile. Further advances in microprocessor control of exhaust gas recirculation and fuel injection should relax this tradeoff. While meeting of a NOX standard of 1.0 grams per mile in conjunction with a particulate standard of 0.2 grams per mile, or less, appears technologically feasible, attainment of the Clean Air Act research goal of 0.4 grams per mile of NOX appears unlikely for diesel engines. The technology for simultaneously meeting the NOX standard of 1.0 gram per mile and 0.2 grams per mile particulate standard is known, but needs further development before application to the entire passenger car fleet.

Resolving the potential adverse public health implications of the carcinogens present in diesel exhaust should remain a high research priority. The role of diesel particulate in photochemical smog requires research. The impact of diesel particulate upon visibility reduction and soiling requires assessment to establish the magnitude of these generally well-recognized problems.

The automobile industry, both in the United States and abroad, is well equipped to develop environmentally acceptable diesel engines. To insure an aggressive development program by the industry, a clear understanding of the effects of diesel emissions backed by stringent emission standards with reasonable time schedules is necessary. Although the diesel passenger vehicle is the focus of this hearing, I must remind the committee that heavy-duty diesel trucks and buses and medium- and light-duty trucks will prove an even greater environmental problem during the next 10 years.

I look forward to your questions and to the panel discussion.

Mr. GORE. Thank you very much. And before questions, we would like to now hear from Mr. John Blizard, executive director of the Manufacturers of Emission Controls Association.

Mr. BLIZARD. Good morning, Mr. Chairman and members of the committee. I am John Blizard, executive director of the Manufacturers of Emission Controls. My testimony is presented on behalf of the members of our association who are working on the development of devices for control of particulate emissions from diesel-powered automobiles.

MECA is a group of high-technology companies that came together because of mutual interest in the business of controlling emissions from gasoline automobiles. Our main concern, since the early 1970's, has been development and production of the catalytic converter. We now, collectively, supply these emission control devices for all domestic and imported cars. We ship to Europe and Japan. Australia will soon be using our converters. The Clean Air Act has created a large new business. Furthermore, it has forced the creation of a most valuable new technology and many thousands of new jobs. Our own companies employ about 2,500 scientists, engineers, designers, and other specialists. Many more are employed in the auto industry.

Now, in 1982, most of our members are hard at work on devices to trap diesel particulates. Our efforts are justified, we believe, because there is an EPA regulation in place that will require strict control of diesel particulate emissions by 1985. While none of our members is assured of business, each is counting on a market being created. Each is willing to bet that his particular approach will succeed in gaining a share. We are racing to get the best product for a 1985 market.

As with the catalytic converter development, we have a regulation in place that is stimulating the development of new technology for a social benefit.

Where are we today? One of our members, Johnson-Matthey, has successfully completed a 50,000-mile durability test, using his own vehicle and providing all necessary test services. The trap performed well, holding emissions below the limit set by the regulation. There was a minor loss in fuel economy, but this can be overcome, it is believed, if the trap and muffler functions are combined in one unit.

My own employer, Corning Glass Works, is also well along in its development of a trap. We have not performed any road tests of our own, but our traps have been extensively tested by every maker of automobile diesel engines. We are confident that an effective device can be provided.

Other participants in MECA are working on ways to trap diesel particulates: UOP Inc., Engelhard Corp., Degussa Corp., W. R. Grace & Co., 3M Co., NGK-Locke Inc. Each is a creative company, with strong technical resources. Together, they can make a formidable attack on engineering problems.

Our principal concern today is that the regulation now on the books may be removed, or grossly relaxed. If this happens, we lose our incentive, and most of us, perhaps all, would transfer efforts to a field with a better future. This is why we have been urging retention of the 0.2-gpm standard, even if this means setting its effective date back to 1986 or 1987. In our view, the best resolution would be to specify the 0.2-gpm level in the new Clean Air Act amendments.

We must make it clear that while the particulate trap is the heart of the control system, it is by no means the complete answer. There must also be a way to dispose of the material collected in the trap, and often enough to prevent back pressure. This is a problem being worked on by the automakers. There are many approaches and much progress has been made. MECA does not pretend to be competing in this area, and we limit our comments to saying again that the presence of the regulation assures that technology will be brought to bear on the problem.

Your letter asking us to participate today posed a number of questions. Some go beyond our level of competence, but we will try to answer where we have views that deserve consideration.

We can add nothing helpful on the growth of the diesel fleet. However, in our view the control of diesel emissions—smoke, oily grime, and particles—will be absolutely essential if we are to allow the diesel fleet to grow much beyond its size today. While the public cannot perceive health hazards from CO and NOX, they are keenly aware of visible diesel pollution. Even now there are many complaints. Public acceptance of a large diesel fleet is essential.

Regarding the 0.2 standard—we are all confident that it can be achieved on a practical and economical basis. Our degree of confidence today is no less than it was in 1972 when we contemplated today's levels of CO and NOX control.

The technologies being proposed or explored by participants in MECA include these:

A fine wire bundle, corrosion resistant and coated with catalyst so that the particles are trapped and the entrained organic chemicals are neutralized by catalytic action.

A porous ceramic honeycomb, arranged so that the exhaust gases pass through its dividing barriers where the particles are trapped.

A version of the ceramic honeycomb that is coated with catalyst on the walls to accelerate destruction of the complex organics.

There are undoubtedly other systems that have not been disclosed for competitive reasons.

It is not possible for me to offer good cost estimates for the various proposals, but others have suggested figures in the neighborhood of $100 for the trap itself. Information about the cost of adapting the traps to the vehicle and providing a means for regeneration must come from the automakers.

Obstacles remaining to be cleared before the particulate trap can be put on production vehicles are mainly in the area of regeneration. The problems here are in learning how to produce temperatures that will burn off the collected particles without damaging the trap itself. Furthermore, the system must be capable of sensing the time when a burnoff is needed—not too soon or too late. And lastly, the system must accomplish burnoff without waste of fuel.

Your question about the Government's role in the research and development of diesel vehicles can best be answered by the automaker rather than by the members of MECA. The highly specialized nature of our business, and the intense competition among our members makes this a field where we all prefer to do our work behind closed doors. Providing an incentive for us to employ our technology is the greatest contribution the Government can provide—as a matter of fact, this is essential.

I will be pleased to answer your questions to the best of my ability.

Mr. GORE. Thank you very much. You have both presented excellent statements that are very helpful to the subcommittee's efforts.

Professor Sawyer, what is your assessment of the efforts by the Japanese and by Cummins to develop ceramic diesel engines, our all-ceramic engines?

Mr. SAWYER. Cummins in the United States and possibly other manufacturers, but especially Cummins and Japanese manufacturers are making progress toward diesel components made of ceramics. The Japanese have a vehicle on the road which has a number of ceramic components in it. I think it is a promising new technology and an exciting one. Its full advantages need to be combined with a different type of diesel engine cycle, I believe, to get the added efficiency which is potentially available there. Its application may make sense most in large engines for trucks rather than automobiles initially. Eventually this technology may provide a reduced manufacturing cost, which I think probably excites the small engine manufacturers in Japan, primarily.

Mr. GORE. What kind of leadtimes are we talking about with respect to the ceramic engines?

Mr. SAWYER. I would expect that you will begin to see ceramic components in engines, prechambers, for example, very shortly. A total ceramic uncooled engine in production could be available within 5 years if the decision I believe were made to go ahead with that.

Mr. GORE. Well, that is fascinating. Do you stand by the NAS recommendations? Let us move to that. Given the added information of the past year and a half?

Mr. SAWYER. Please understand that a committee effort such as the National Academy of Sciences studies involves a lot of people and a lot of compromise, and I do not think every one of us is absolutely behind every conclusion reached. That study was completed 18 months ago, and unfortunately because of the Academy review process the final report has just now come out.

Mr. GORE. Redtape and bureaucracy?

Mr. SAWYER. Yes. As far as the importance of this to the significance of the technology panel report for which I was responsible, I do not think it is quite as serious as Mr. Doniger would indicate.

There certainly has been technology coming along since that time, especially the 50,000 mile demonstration of the trap system. No new technology has been demonstrated in the last 18 months. We recognized and assessed everything being considered at the present time; therefore I believe the document still holds up fairly well.

Issues were also raised concerning the risk-benefit analysis, and I think you have to say that this type of analysis is very difficult to do in areas where there are such high uncertainties in areas such as health effects of diesel particulates.

Mr. GORE. What about the lifetime of diesel automobiles compared to the lifetime of gasoline automobiles?

Mr. SAWYER. We anticipate that they will be comparable. Unlike the perception that the heavy engines are durable, engines developed for use in light-duty vehicles are higher speed and there is no expectation that their lifetime will be significantly greater than gasoline engines.

Mr. GORE. What is it now?

Mr. SAWYER. We anticipate that automobiles will be designed for a lifetime going with the body of the vehicle. Engines have lasted 100,000 miles without a major overhaul, and we anticipate that that goal will remain for large and small engines. It is more difficult for small engines.

Mr. GORE. Is it a myth that diesel—well, let me strike that from the record.

Some people believe it is a myth that diesel automobiles will be longlasting as the larger ones are, and is it fair to say that the current diesels are expected to have a shorter lifetime than gasoline automobiles?

Mr. SAWYER. No; I do not believe that is the case at all. I think that it is a standoff between the two, that one offers no particular advantage over the other in durability or lifetime in light-duty applications.

Mr. GORE. What about the general engineering problem with diesels? Would you comment on that?

Mr. SAWYER. In many respects the technology of the diesel is still quite crude compared to gasoline engines. There is lots of development work available which is an exciting prospect for the diesel. A number of improvements are being made at the present time, and there are a number which we can look forward to. The advances are not occurring entirely in the United States, but there are important developments overseas as well. I would point to the engine which has been developed by AVL and will be utilized by BMW and Ford, an advanced-technology direct injection high efficiency diesel engine. That is an important step forward. The application of microprocessor controls to diesel engines is an important field which is progressing rapidly in the United States and overseas. The Robert Bosch Corp. is perhaps the leader, but the Japanese are working on more sophisticated control systems for the diesel engine. Materials is another area in which the diesel engine will continue to move ahead. Application of turbochargers will see more use in the years ahead. I see substantial improvements in diesels during the next 5 years.

Mr. GORE. What about the tradeoffs between emissions control, fuel economy, and marketability?

Mr. **Sawyer**. My general perception is that the tradeoffs are exaggerated in all respects, that often the technology which is required to meet emissions standards is also required to improve driveability, is required to improve fuel economy. And that as the new technology is developed for any one of these, it tends to help all the rest. This is contrary to the behavior of some current engines where it is certainly the case that as you put more exhaust gas recirculation in an engine to reduce oxides of nitrogen, you can increase particulates or degrade fuel economy. I think that is a consequence of a single parameter effect on the fixed design engine, and that when the systems are optimized the severity of the tradeoff can lessen or disappear entirely.

Mr. **Gore**. What about the trap oxidizer in this regard? What about the problems that it presents with respect to cost durability and regeneration systems?

Mr. **Sawyer**. I think there is no question that there is a cost to such a system. I doubt that it will be the $600 or $1,200 figure which we have heard mentioned; $600 was used in the Academy of Sciences report as the upper limit. If one takes proper accounting for components that will not be necessary, such as the muffler, the costs become more reasonable. I do not believe that the system offers any major problem with fuel economy, that there should not be any degrading of fuel economy. There may be operational problems, and certainly the control of the lightoff is the major difficulty now. A reliable system for sensing when the trap needs to be ignited for carrying out the ignition process remains to be demonstrated. I am confident that the automobile industry is working on this aggressively.

Mr. **Gore**. GM is going to testify that in their view a trap oxidizer is the least promising control technology. Do you agree or disagree?

Mr. **Sawyer**. I think that the trap oxidizer will always be available to reduce the particulate emissions by a factor of 50 to 80 percent, and depending upon the level of control which is necessary, I think it is a very attractive technology. I personally would prefer to see greater efforts on improving the engine, the fuel injection system in particular, to reduce engine-out emissions as far as possible. I think as that is done that many engines will meet the 0.2 gram standard without the trap oxidizer.

Mr. **Gore**. If they choose to go with the trap oxidizer, do you think that the 1985 timeframe is a realistic one?

Mr. **Sawyer**. I think it is too soon for the entire fleet. It seems unlikely that these systems can be developed and put into large-scale production by 1985. The time is too short to do that.

Mr. **Gore**. Mr. Blizard, you have a lot of expertise in this area. What has to be done to the trap oxidizer once the automobile manufacturer has purchased it?

Mr. **Blizard**. First I should make clear that I am speaking for an association of companies, all of whom are trying to make trap oxidizers of various types. My own company is working hard on one, so my expertise would come from what I have learned from my own company. I will speak from what we know.

The problem is to develop a trap oxidizer that can withstand the high temperatures of burnoff, that can collect a reasonable amount of particulate before it needs to be burned off, that can be mounted in a metal can so it is not over stressed. We are confident that it can be done. We do not say that it is ready today. We are participating in a test in California where a fairly large Mercedes is up to about 35,000 miles with one of our traps and apparently doing very well, holding particulates to a level well below the two-tenths. So I think it is a matter really of adapting a mechanical device to the vehicle and it is a matter of discovering temperatures that the device must withstand, and being sure that you have engineered your piece to resist them.

Mr. GORE. What about the 1985 timeframe? Do you think that is a realistic one?

Mr. BLIZARD. Well, if you took a poll of the various members of our group working on trap oxidizers, you would find that the span is from 1985 to 1987.

Mr. GORE. Let us assume—I am prepared to assume your company's version is the best, but let us assume for purposes of argument just as a hypothetical case that the Johnson-Matthey version is the way that people go. How soon could that version—how soon could they supply all diesels sold with trap oxidizers, just as a hypothetical case?

Mr. BLIZARD. Well, I think Johnson-Matthey would respond that they could go into production and make as many of the traps as anyone would need for 1985 cars.

Mr. GORE. I see.

Now, what about the problems related to regeneration?

What are we looking at there?

Mr. BLIZARD. Well, the problems are making the regeneration automatic and convenient and trouble free.

Mr. GORE. Well, are you assuming in the 1985 to 1987 date that——

Mr. BLIZARD. Absolutely. You could not go into a car that has to be taken off the road and regenerate and go back on the road again.

Mr. GORE. It has to be done?

Mr. BLIZARD. It has to be an automatic.

Mr. GORE. You think it can be done by as early as 1985?

Mr. BLIZARD. No; I don't want to make the mistake of pretending to be competent in that area.

Our people make traps, and we sell these or give these to automakers, and they are the people who have the burden of figuring out how to adapt this to their car, and it would be different for this kind of a car, this kind of a car, and so——

Mr. GORE. Well, but the generic problem of regeneration is one that the companies that you represent are working on, isn't it?

Mr. BLIZARD. No, no, we are not.

Mr. GORE. What about maintenance?

You are not, surely you concern yourselves with the problems that will be faced with respect to maintenance?

Mr. BLIZARD. Indeed we do, and we expect that the trap will be a passive device that sort of sits there in the car and functions with no attention being paid to it at all.

Right now, that is a dream. That is something that is not achieved yet, but if regeneration systems are worked out, then the trap, we hope and think, is going to be like a catalytic converter which sits in the car passively, and is there for 50,000 or 100,000 miles with no trouble.

Mr. GORE. If it is a dream, your earlier response assumes that that dream will be realized sometime between 1985 and 1987?

Mr. BLIZARD. Indeed, and the fact that we are working hard on our part of the system, and that our competitors in our association are working just as hard as we are is evidence that we believe that this will be solved, and can be solved.

Mr. GORE. It is 1982 now.

Mr. BLIZARD. In 1972, we were talking about the catalytic converter with many of the same caveats.

Mr. GORE. Let me come back to regeneration, since you mentioned the catalytic converter. Are you saying that that is a problem for the auto companies and not for your manufacturers?

Mr. BLIZARD. Regeneration is a problem that the auto companies are working on. They are the ones who are capable of working on it. To the extent that we could help or cooperate, of course, we would do it, but it is an area where they have the competence.

Mr. GORE. Would you agree that it is a problem that has to be solved before the trap oxidizers are installed?

Mr. BLIZARD. Oh, yes.

Mr. GORE. Well, then you are assuming in your estimate of 1985 to 1987 that it is a problem that they, the auto companies, will solve between now and then?

Mr. BLIZARD. We are.

Mr. GORE. You don't think it is a difficult problem to solve?

Mr. BLIZARD. Well, I think it may be a difficult problem, but we would not be investing the time and money in the development of the trap, if we didn't think that it was a problem that could and would be solved.

Mr. GORE. Well, you mentioned the catalytic converter program. They had an early problem with sulfuric acid emissions and excessive heat, and it was blamed on the fact that they were put in without sufficient development.

Might not the same thing happen with trap oxidizers if we go that way?

Mr. BLIZARD. Let me just speak to that presumption that they were put in without adequate development.

The sulfuric acid problem never developed. It was a fear and a concern, but it was found not really to be a problem.

General Motors did an enormous experiment, very valuable experiment, which showed that this is nothing that we had to worry about.

Mr. GORE. Professor Sawyer, I would like to ask you to comment on the question of regeneration.

What incentive does the auto companies have to work on regeneration?

Mr. SAWYER. The only incentive is the regulatory one; that they must meet the standard as it appears on the law books at the present time.

Mr. GORE. You are recommending that we delay that standard?

Mr. **Sawyer**. From the standpoint of technological feasibility, that it needs to be delayed or at least that a waiver provision be put in.

I suspect that by 1985 we could see some vehicles operating with regenerative traps, but not the entire fleet.

Mr. **Gore**. If the only incentive for the auto companies to solve this difficult problem is to meet the regulation, if the regulation is delayed, the companies making the trap oxidizers are saying, we are not going to solve this; it is up to you to solve it.

The auto companies say the only incentive we have to solve it is the deadline in the regulation. You delay the regulation, the problem is not going to be solved?

Mr. **Sawyer**. There is a faulty assumption, and that is that the industry is not cost-competitive. It is competitive—within the United States perhaps not so competitive—because there is only one large manufacturer of diesel engines, but worldwide there is a very aggressive competitive industry which you can count on will be developing technology as rapidly as possible.

Outside the auto industry, there are suppliers who are also working on control systems; for example, Robert Bosch Corp.

Mr. **Gore**. Over half of the diesels sold in the United States are GM, and they are the only diesels made within this country; so, within this country, it is not really competitive.

If you look at the Rabbit and Audi, Mercedes, Volvo, you see some competitive pressure, but it is of a particular kind.

What about installation, Mr. Blizard? What problems will the auto manufacturers face with respect to installation of these things?

Mr. **Blizard**. I don't anticipate any out of the ordinary problem at all.

Mr. **Gore**. Are there more tests on trap oxidizers available other than the one done by the Southwest Research Institute on the Johnson-Matthey trap?

Mr. **Blizard**. Yes. EPA is running a test which we were participating in, and that is a test where our trap is operating at about up to 35,000 miles.

There are many, many more tests being made in-house by the auto companies, and that is their business, and they are the people who own that information and have developed it and would speak to it.

Mr. **Gore**. OK. Thank you very much.

Mr. Walker?

Mr. **Walker**. Thank you, Mr. Chairman.

Mr. Blizzard, you mentioned the EPA study, where your trap is being used in a fairly large Mercedes, 35,000 miles? What size engine is that?

Mr. **Blizard**. 300.

Mr. **Walker**. OK, and has that been run, that 35,000-mile duration test—has that been run at sustained speeds of 55 miles an hour and above?

Mr. **Blizard**. I am not sure it has been run over 55 miles an hour, but run in normal driving schedules, not a tightly prescribed schedule.

Mr. **Sawyer**. I am not familiar with that.

Mr. **Blizard**. I would imagine it probably has been driven at faster than 55 miles an hour.

Mr. **Walker**. That primarily is related to the fact that I understand that one of the problems has developed in some of the long-term tests is that when at sustained speeds of 55 miles an hour, particularly if sustained speeds go above 55 miles an hour, there is some significant problem with overheating. That has not been discovered in the course of this 35,000 mile test?

Mr. **Blizard**. No.

Mr. **Walker**. Regeneration, that is something which the automobile companies have to work on, and you also made it very clear that it will be essential to have an automatic system, that you cannot have systems like the present ones where the owner would have to have substantial control.

Does that exist, to your knowledge, today?

Mr. **Blizard**. I really do not know of any.

Mr. **Walker**. OK.

Mr. Sawyer, you mentioned in your testimony something about fuel, that there is a question on quality of fuel, and doesn't that really relate to some of the questions that we are raising here with regard to trap oxidizers, too; that some of the assumptions in the research there have been that you have fairly high quality fuel; that the engine is operating at peak efficiency; that we don't have abuse of the engine, so that you have a chance of fouling, which, of course, can be a very substantial chance if somebody does not properly maintain it, and you seem to add a question into it as to the quality of fuel into this whole thing.

Mr. **Sawyer**. The issue of maltreating the engine and maintenance is not such a serious one for the diesel engine. It seems to be one advantage; that it is pretty resistant. There are not too many reasons why an owner would or could maltreat the engine.

That is an advantage over a pollution control-equipped gasoline engine.

The other issue of fuel quality is a very important one, and a very difficult one.

I think that what we need to be concerned about is not a higher quality diesel fuel but simply holding the diesel fuel at the quality which presently exists.

As the demand for diesel fuel increases and the quality of crude stock decreases, the refiners will be tempted to market lower and lower quality diesel fuels.

This could have serious adverse effects on the emission characteristics and the general operating characteristics of the engine, the drivability of the engine.

There is no provision for establishing or maintaining the quality of diesel fuels other than what the marketplace will bear.

This appears to be in error. The State of California is moving ahead to provide some regulations on the quality of diesel fuel. Sulfur content is something which should be looked at carefully and an absolute maximum level established for auto diesel fuel.

Mr. **Walker**. The trap oxidizer technology, as it now exists, if the quality of the fuel was significantly lower, it would pretty much render the present technology of trap oxidizer impotent?

Mr. SAWYER. That would not be the problem. The difficulty would be that the engine out-emissions and, therefore, if the trap oxidizer had a fixed percentage reduction capability, that what came out of the exhaust would also go up, but one would expect the trap oxidizer to work reasonably well, even with higher particulate loadings, if it were fully automatic.

Mr. WALKER. You, of course, were a part of the committee for the National Research Council study.

Would you say that the findings in that study indicated that there are no health effects that would lead us toward a technology-forcing standard?

Mr. SAWYER. Please understand that I am not a medical person, but I listened very carefully to all of the medical evidence which was provided. If you read the Academy of Science's report carefully, it says that there is no reason, well identified now, to stop the diesel engine; that is certainly not an option which we should move ahead on. There are a number of concerns raised and issues raised, and I think that perhaps the most important indication of concern is that the report asks for a 3-year periodic review of the health effects issues of diesel engines, one which should come before 1985.

This establishes the concern which goes with the high uncertainty which exists in the effects of diesel exhaust.

Mr. WALKER. One of the things that was indicated in that study was that in the Denver area, that visibility may be reduced up to 50 percent by particulate emissions from light-duty diesels.

It is my understanding that those calculations used as a basis were in error, and the 50-percent figure is high by more than a factor of 10.

Since you were a member of the committee, could you clarify that for us for the record?

Mr. SAWYER. Fortunately, the people who have raised this issue from General Motors, who were kind enough to let me know that they were raising the issue, I have not had a chance to talk to the people responsible for those calculations, but I have looked at the numbers.

There does appear to be some difficulty with the projections for the Denver area. I would not endorse that they are off by a factor of 10, but a 50-percent reduction does not, to my first look, appear to be the correct number, from what you would expect from the dieselization.

The simple reason is that the impact of light-duty diesel emissions in the Denver area will not override that of existing and growing heavy-duty diesel emissions and, therefore, that type of impact seems to be unlikely.

Mr. WALKER. And I have understood, and you say you just have not had a chance to look at it. I have understood instead of 50 percent, the figure may be close to 3½ to 5 percent.

Mr. SAWYER. I am not prepared to say what that number is.

Mr. WALKER. It could be significantly lower.

Mr. SAWYER. Yes.

Mr. GORE. Mr. Blizard, you mentioned that there were other studies besides the one at the Southwest Institute on trap oxidizers, and could you elaborate on those other studies?

Mr. **Blizard**. No; I can't, because those are studies being done by people who make automobiles, so they are——

Mr. **Gore**. I see. Could you identify the companies that are doing those studies?

Mr. **Blizard**. Every company that makes a diesel car is investigating this.

Corning has sold or given traps to every company that makes diesels.

Mr. **Gore**. So GM, Volkswagen, Mercedes, Peugot, and Volvo are all conducting studies at the present time?

Mr. **Blizard**. Well, they have the traps, and they are working on them, and, really, that is all I am at liberty to discuss.

Mr. **Gore**. Did you say that EPA is doing a current study?

Mr. **Blizard**. EPA is participating in a study in California, and we have a trap on that car.

Mr. **Gore**. I see. Who else is participating in that study?

Mr. **Blizard**. Southwest Research.

Mr. **Gore**. I see; so that is the same one?

Mr. **Blizard**. Yes.

Mr. **Gore**. So there is a Southwest Research study that we know about, and then, according to your testimony, each of the companies is separately engaged in other tests of trap oxidizers?

Mr. **Blizard**. Yes. I have no idea what each of these companies is doing with the traps, but I know that many of them—I know many of them were working on them intensively, and presumably the others are doing something.

Mr. **Gore**. I see. Well, we will explore that.

Mr. **Walker**. I have one more question, if I could, Mr. Chairman.

Mr. **Gore**. Sure.

Mr. **Walker**. Much of the talk recently about the advanced nature of the trap-oxidizer system has surrounded the Johnson-Matthey system.

Now, as I understand it, the 50,000-mile test run by the Southwest Research Institute was on a Rabbit, and one of the reasons why that was done is because it was said that the Rabbit represents approximately the size and weight of the vehicle that we would have in 1985, but the contention was, as I understand it from Dr. McGuire, of Johnson-Matthey, is that comparable results could be achieved on heavier vehicles if they were a part of a fleet.

Do you know whether there is any basis for that kind of statement?

Mr. **Blizard**. I can't speak for that.

Mr. **Walker**. Do you know if there is any data around for any tests of heavier vehicles?

Mr. **Blizard**. I do not know.

Mr. **Walker**. There are some documents in the public domain which indicate when they put that same trap oxidizer on a V-8 engine of an Oldsmobile size or weight, that it failed very, very quickly, and didn't come anywhere close to the 50,000 miles achieved with the Rabbit; so that I think that that is one of the questions that would have to be raised in terms of the 1985 standards.

I thank you very much.

Mr. **Blizard**. Right.

Mr. GORE. I would like to thank both of you gentlemen and, Professor Sawyer, thank you for flying such a great distance and the unpleasant hours to be here with us and Mr. Blizard. We thank you very much for your testimony, and both of you are excused at this point.

We thank you.

Our next witness is representing General Motors, and we would like to call Dr. Craig Marks to come forward, executive director of the environmental activities staff at the GM Technical Center, and I believe you will be accompanied, Dr. Marks, by Dr. Jaroslav Vostal, head of the Biomedical Science Department at GM Research Laboratories, and Mr. David Dimick, executive engineer with the engineering staff of the GM Technical Center.

I would like to welcome all three of you to the hearing, and we appreciate the trouble you have gone to, to be here.

Dr. Marks, without objection, the entire text of your prepared statement will be put into the record.

We invite you to proceed as you see fit.

STATEMENT OF DR. CRAIG MARKS, EXECUTIVE DIRECTOR, ENVIRONMENTAL ACTIVITIES STAFF, GENERAL MOTORS TECHNICAL CENTER, ACCOMPANIED BY DR. JAROSLAV VOSTAL, BIOMEDICAL SCIENCE DEPARTMENT, GM RESEARCH LABORATORIES, AND DAVID DIMICK, EXECUTIVE ENGINEER, ENGINEERING STAFF, GM TECHNICAL CENTER

Dr. MARKS. Thank you, Mr. Chairman. You have correctly identified my partners here at the table, and we appreciate the opportunity to provide information to your subcommittee.

We will review briefly the written statement. I will summarize it very briefly in the areas of market demand, potential environmental health impacts, emission control technology, and needed research and development as indicated in your letter of invitation.

Dr. Vostal will provide some additional information on the health effects issue, and Mr. Dimick will review the status of emission control technology in more detail.

As fuel prices have increased in recent years, the market demand for diesel engines has expanded into passenger cars and into light as well as medium-duty trucks.

The diesel penetration of these markets at present, however, is still relatively small.

In 1981, about 8 percent of the passenger cars General Motors built, 4 percent of the light-duty trucks, and about 15 percent of the medium-duty trucks were diesels.

Of course, these figures do not represent the proportion of diesels in the fleet in use, since it takes about 10 to 15 years to replace most of the old vehicles with new ones. For instance, the total passenger car fleet at this time only contains about 1.3 percent diesels.

About 2 years ago, we projected that 20 percent of the new passenger cars, 30 percent of the light-duty trucks and possibly 50 percent of the new medium-duty trucks would use diesel engines by the late 1980's.

This long-term demand for diesels as an option to gasoline engines in passenger cars and light trucks will be determined primarily by the balance between diesel engine operating and economic characteristics compared to gasoline engines.

Thus, the current situation of adequate fuel availability and the prices of unleaded gasoline and diesel prices being approximately the same has had a negative impact on diesel sales.

Now, it is too early to be certain, but, based upon the sales trends since we have made the earlier projections, we now estimate a band of possible values—from a low of 10 percent to a high of 20 percent—of General Motors new passenger cars will be diesel powered by the late 1980's, and from a low of 20 percent to a high of 30 percent of our new light-duty trucks will have diesels.

Our analysis of the medium-duty trucks, the group between 10,000- and 25,000-pound gross vehicle weight, is even less certain. With the current and projected prices of fuel, we now do not expect that this group of trucks will be as heavily dieselized in the near future as our earlier projections, but we don't yet have an estimate of this change in usage.

This lack of certainty about market demand does make it difficult to plan new product and facility needs. But an even larger uncertainty regarding the future use of diesels is caused by the pending regulations that have been discussed earlier in this hearing.

There is major uncertainty about the ability of diesel engines to meet the particulate emission level currently specified by the EPA regulation, as well as the NOX emission requirement in the current Clean Air Act.

The committee asked about the scientific basis for the present EPA particulate standards. GM has objected strenuously to the 1985 standard on the basis that it was issued by the agency in an erroneous interpretation of the Clean Air Act.

EPA did not cite a health or air quality basis, but rather set this standard "to fulfill the greatest degree of emission reduction mandate of the Act."

The U.S. court of appeals has agreed that this technology-forcing mandate is the wrong section of the act on which to base the light-duty particulate standard. It seems clear that the two-tenths level represents a greater degree of stringency than Congress intended and was based on an overly optimistic evaluation of the capability of technology to meet this level.

As Dr. Vostal's statement will detail, there is no basis for concluding that dieselization of a portion of the U.S. fleet would pose a lung cancer hazard or could lead to any significant increase in nonneoplastic respiratory diseases at the expected ambient particulate levels. While a finite number of laboratory tests cannot prove that diesel exhaust will never have a health impact at any time, it may be concluded today that the weight of evidence from Government and privately sponsored research has shown no indication of an adverse health effect after 4 years of extensive testing.

In contrast, dieselization of the light-duty fleet will have a small effect on total suspended particulate levels. Assuming a total fleet dieselization as high as 15 percent of cars and light-duty trucks which, of course, will not occur for many, many years, we calculate that the ambient particulate increase still will be small. We estimate that this level of dieselization will add less than 2 micrograms per cubic meter to ambient particulate in the year 2000.

This increase, however, will cause a reduction in visibility in central city areas.

Assuming a 1-percent growth in vehicle miles traveled, we estimate that by the year 2000, visibility reductions may range from 3 to 7 percent for major U.S. cities, except for Los Angeles, which is a unique situation.

Three approaches are being pursued to reduce diesel particulate emissions, combustion chamber changes, modification of fuels, and after treatment or trap systems.

Changes in combustion chamber configuration and injection characteristics have already significatly lowered the particulate emissions from our passenger car engines. This has been referred to earlier.

However, it is not anticipated that further really significant reductions will result from this type of work. We also have conductd extensive studies in conjunction with petroleum and additive manufacturing companies to try to find fuel modifications which will result in lower particulate emissions.

A practical low particulate fuel, however, has not yet been identified. The only way known to approach the 1985 EPA particulate emission standards is by using a trap device which collects the particles on a filter and periodically burns them off.

This burnup process is called regeneration. Many different materials have been found which are efficient in trapping particulates.

The regeneration process, of course, is much more of a technical challenge.

Regeneration systems developed to date are complex and have not performed successfully on a repetitive basis. Unfortunately, to date, our experimental traps with regeneration have only been successful at low mileage, and Mr. Dimick will give you more detail on this work.

In addition to problems of durability and complexity, these devices certainly will add significant costs to the diesel engine option. With the limited state of development to date, cost estimates are necessarily speculative.

However, most trap systems we have tested, would cost about $500 per car, which is well above the price increase we think would be tolerated from the standpoint of its impact on the marketability of this engine option. The ability to meet particulate emission requirements also is critically dependent on the oxides of nitrogen standard which the diesel engine must meet.

Diesel NOX emissions are difficult to control to have low levels, and the most effective means of control can have serious adverse effects on engine durability, fuel economy, and driveability. EGR also increases hydrocarbon and particulate emissions. At low EGR levels such as used in our current engine systems, the effects do not seriously degrade engine durability nor cause the engine to exceed other emission standards.

The level of EGR required to approach the 1-gram-per-mile passenger car NOX standard essentially causes the particulate emission rates to double in some of our engines. With respect to the last subject, Government research on diesel engines, GM believes that it is appropriate for Government to fund research that will expand the basic engineering knowledge of diesel engine processes and enhance the long-term development and mix of diesels.

Examples of such research are the areas of basic combustion, materials and health effects. In summary, then, the future availability of diesels in passenger car and light duty trucks is certainly very dependent upon the regulatory requirements.

Clearly, if this engine is to play a significant role in future fuel conservation efforts, the emission requirements placed on it should be limited to only those which are really needed to meet the Nation's air quality goals. The penalty of overstressing emission requirements for this engine could mean elimination of its use in light duty vehicles, which would put in jeopardy a GM capacity of 1 million vehicles per year and employment of about 4,500 people.

If you would like, I think Dr. Vostal has a little more information that he could give you on the health effects work that has been done.

[The prepared statement of Dr. Marks follows:]

GENERAL MOTORS STATEMENT ON DIESEL ENGINE TECHNOLOGY

I am Dr. Craig Marks, Executive Director, General Motors Environmental Activities Staff. With me are Mr. David L. Dimick from the General Motors Engineering Staff and Dr. J. J. Vostal, head of the Biomedical Science Department, General Motors Research Laboratories.

General Motors welcomes this opportunity to review with you our diesel engine development activities and our views on the future use of diesel engines. Diesel engines are an important part of our products now and will continue to be so in the future. Discussions of this kind should consider a number of subjects: market demand, technology development, and potential environmental and health impacts. A review of these subjects is necessary to place them in proper perspective since they are important to Congressional deliberations on many issues.

DIESEL ENGINE USAGE

The primary reason for General Motors interest and ongoing efforts in diesel engines stems from our customers' interest in the higher efficiency of the diesel engine. The diesel engine provides substantially better fuel economy than gasoline engines in comparable service. For passenger cars and light duty trucks, our current diesel engines show an improvement of about 25%. In heavier truck applications, diesels show even larger increases in fuel economy, the magnitude being dependent on the type of truck operation.

The market demand for diesels has increased with higher fuel prices. A strong demand for heavy duty diesel engines has existed for several decades. Long-haul trucks, large off-highway vehicles (such as locomotives and agricultural, construction and earth-moving equipment) and many types of stationary power units are almost exclusively powered by diesel engines. During recent years, the market for diesel engines has expanded into passenger cars and light and medium duty trucks, which before were primarily powered by gasoline engines. The diesel penetration of these markets at present, however, is still relatively small. In 1981, about 8% of the passenger cars General Motors built, 4% of the light duty trucks, and about 15% of the medium duty trucks were diesels.

General Motors expects these figures to increase over the next ten years. We also would expect other manufacturers to expand the availability of diesel engines for their products, but it is apparent that our product plans have led most of the industry by a few years.

We have made estimates of the market demand for diesels in the past. About two years ago, we projected that 20% of the new GM passenger cars, 30% of our light duty trucks and possibly 50% of our new medium duty trucks would use diesel engines by the late 1980's. This does not mean that the fleet of vehicles on the road would have this proportion of diesels at that time, since it takes ten to fifteen years to replace most of the old vehicles with new ones. For example, although 8% of 1981 GM passenger cars are diesel powered, the total passenger car fleet contains only 1.3% diesels. However, this projection indicated that a significant portion of the fleet would be powered by diesel engines by 1990.

The long term demand for diesel engines as an option to gasoline engines in passenger cars and light trucks will be determined primarily by the balance between diesel engine operating and economic characteristics, compared to gasoline engines. The suitability of diesels for these applications has been enhanced by many engineering improvements during the past few years. Historically the diesel engine has had several disadvantages such as high weight, low power, hard cold starting, smoke, noise, odor and cost. Many of these characteristics have been improved significantly. Diesels still bear a cost penalty, however, and, increasingly, customers are weighing this penalty against the prime benefit - improved fuel economy - in making their purchase decision. Thus, the current situation of adequate fuel availability and diesel fuel prices which generally are at or above the price for unleaded gasoline has had a negative impact on diesel sales. Several oil companies have individually indicated that this price equality of diesel fuel and unleaded gasoline will probably continue, and this raises questions about the long term proportion of passenger car and light trucks that will use diesels.

It is too early to be certain but, based on sales trends since our earlier projections, we now estimate a band of possible values from a low of 10% to a high of 20% of General Motors new passenger cars will be diesel powered by the late 1980s and from a low of 20% to a high of 30% of our new light duty trucks. As stated earlier, the availability and the relative price of unleaded gasoline and diesel fuel will determine the actual market penetration of diesel vehicles.

Our analysis of the medium duty trucks, the group between 10,000 and 25,000 pound GVWR, is even less precise. The changeover of this group of trucks from predominately gasoline engine powered to mostly diesels, will depend on the customers' perception of the total cost of ownership during the useful life of the vehicles. With the current and projected prices of fuel, we now do not expect that this group of trucks will be as heavily dieselized in the near future as our earlier projections, but we do not have a good estimate of this change in usage yet.

This lack of certainty about market demand makes it difficult to plan new product and facility needs, but by far the largest uncertainty regarding the future use of diesels is caused by pending regulations. There is major uncertainty about the ability of diesel engines to meet the nitrogen oxides (NOx) emission requirements in the current Clean Air Act and the particulate emission level currently specified by EPA regulation. There is both a technological feasibility problem in meeting these requirements and a marketability concern even if the technology becomes available.

Diesel NOx emissions are difficult to control to very low levels and the most effective means of control, exhaust gas recirculation (EGR) can have serious adverse effects on engine durability, fuel economy and driveability. EGR also increases hydrocarbon (HC) and particulate emissions. Currently, light duty diesel vehicles meet the waived NOx standard of 1.5 grams per (gpm) but the Clean Air Act presently requires that this be reduced to 1 gram per mile for model year 1985. At the present time, no control techniques exist to assure meeting this standard, except possibly for the smallest vehicles.

The only way known to approach the 1985 EPA particulate emission standard is by using a device which collects the particles on a filter and then periodically burns them off. In addition to problems of durability and complexity, this approach will add significant cost to the diesel engine option. General Motors has estimated the cost of one of the more promising experimental particulate control systems to be about $460, assuming that it can be developed to have the required durability without additional cost. An increase in price of that magnitude for the diesel option would further limit its marketability and sales.

The future viability of diesels in passenger car and light duty trucks is very dependent upon these regulatory requirements. If this engine is to play a significant role in future fuel conservation efforts, the emission requirements placed on it will have to be limited to only those which are really needed to meet the nation's air quality goals. The penalty of overly stringent emission requirements for this engine easily could mean the elimination of its use in the light duty vehicle market.

DIESEL ENGINE DEVELOPMENTS

General Motors still believes that the light duty vehicle market will support a variety of diesel engines, and we remain committed to providing our customers this choice in many of our products. We have continued to develop new engine designs and have invested in new production capacity to meet this committment. We started by building a light duty diesel suitable for our largest passenger cars and station wagons. The improved economy of diesels produces the greatest fuel conservation benefit in these large vehicles and for many families these larger vehicles are the most practical to own. Larger engines, however, do have greater difficulty meeting stringent emission requirements.

Recently, Oldsmobile Division has built a new engine plant to build passenger car diesel engines in Lansing, Michigan, with a capacity of 1600 engines per day and a projected full capacity employment of 1300-1400 people. This capacity is in addition to the existing Oldsmobile plant capable of producing 1500 engines per day. In addition, Chevrolet Division, just this model year, opened a new diesel engine production plant in Dayton, Ohio, for light and medium duty truck applications with a capacity of 1600 engines per day and a full capacity employment of about 1800 people.

At the present time, General Motors produces diesel engines which employ two fundamentally different combustion processes. Our passenger car and light truck engines employ the indirect diesel injection (IDI) process. This combustion system uses a small prechamber into which the fuel is injected, which results in quieter operation and requires a less rigid engine design. The IDI engine has the ability to operate effectively over a wide engine speed range, which is needed for passenger cars and light trucks.

The direct injection (DI) combustion system is employed in diesel engines which are used in large heavy-duty trucks, off-highway equipment and locomotives. In these engines, fuel is injected directly into the main combustion chamber, which avoids the complexity of a prechamber design. The primary advantage of the DI type is its even higher fuel efficiency. In an application where an IDI engine would achieve a 25% improvement in fuel economy over a gasoline engine, the DI would be expected to achieve a 40% gain. However, the DI has had a limited engine speed range, higher noise, higher weight and higher hydrocarbon and NOx emissions.

These differences in the two engine types account for the different applications at the present time. However, developments are being pursued to try to adapt the DI engine to light duty vehicle applications in order to take advantage of its higher efficiency. The success of these efforts will depend significantly upon future emission standards. Overly stringent standards will prevent more widespread use of this fuel efficient technology. If the DI engine were allowed to be produced for a few years with emissions somewhat above the current standards, this could speed the introduction of this more efficient engine technology while development of its ability to meet emission standards proceeds. This can be done without a significant impact on air quality.

Current General Motors vehicle engines include a 5.7 liter IDI V8, a 4.3 liter IDI V6 and a 1.8 liter IDI 4-cylinder for passenger car applications. We manufacture a 6.2 liter IDI V8 for light and medium duty trucks, an 8.2 liter DI V8 for medium duty trucks and a wide variety of DI engines for heavy duty trucks and buses which range in size up to 12 liters. Much larger DI engines are built for locomotives, off-highway vehicles and stationary power sources.

HEALTH EFFECTS

The potential adverse human health effects from increased exposure to diesel particulates is a prime concern of increased dieselization. Some commentators have speculated that since ambient diesel particulate levels will increase and since they are respirable and have adsorbed on them potentially carcinogenic organic compounds, increased use of diesel engines may cause adverse human health effects. This view was supported by the EPA's report that organic solvent extracts of diesel particles are mutagenic in bacterial assays such as the Ames test.

In contrast, the epidemiological studies of the British Medical Research Council conducted on London bus garage workers between 1955 and 1974 gave no indication that diesel exhaust material was a significant hazard as far as the frequency of lung cancer was concerned. This opinion was further supported by the recently published report of the National Research Council's Diesel Impacts Study Committee which concluded that although the existing data on the biological activity of diesel particulate provided,

"few answers and raised many questions....about the potential carcinogenicity of diesel exhaust....neither whole diesel nor whole gasoline engine emissions inhaled by various types of laboratory animals in different experiments has been found so far to induce lung tumors -due possibly to the low carcinogenic activity of the exhaust of both types of engines. (National Academy of Sciences Report, "Diesel Cars, Benefits, Risks and Public Policy, Impacts of Diesel-Powered Light Duty Vehicles," (1982), Summary and Conclusions, Page xiv.)

The Committee found no basis for concluding that dieselization of a portion of the U.S. fleet would pose a lung cancer hazard or that particulate mass emission rates for diesel-powered cars should be further reduced.

In contrast with the speculative predictions based on the Ames test, large research programs undertaken by the EPA, DOE, GM and other engine manufacturers on thousands of animals for periods of up to two years have found no evidence that the expected ambient exposures of large human populations could lead to any significant increase in frequency of lung cancer or other non-neoplastic respiratory diseases. Similarly, skin painting studies with whole particles and particle extracts have also failed to show a deleterious effect on test animals.

Studies were initiated at General Motors Research Laboratories in 1978 with the intention of finding a plausible explanation for these apparent discrepancies. (Attachments I, II, III). The results have indicated so far that, first, the data obtained using organic solvent extracts of diesel particles were of little predictive value for health assessment. This is probably due to the fact that the bioavailability of the adsorbed compounds (solubility in biological fluids) is only a fraction of that obtained using organic solvents which are not present in living tissues. Second, the physiological defense mechanisms of the respiratory system were found effective in rapidly clearing the deposited diesel particles from the pulmonary epithelium. Apparently these defense mechanisms are capable of neutralizing the in vivo aggressivity of the hydrocarbons adsorbed on the surface of the particulate matter. Third, the amounts of diesel particulate deposited and retained in the respiratory system at expected ambient concentrations were assessed to be far below the dose levels required to produce biochemical or immunological effects in living organisms.

It may be concluded, therefore, that in spite of the theoretically predicted carcinogenic properties of the particulates, no definitive evidence has yet been found to implicate diesel emissions as a threat to public health, at the higher market penetration we earlier projected for light-duty vehicles. The suspected cancer-producing (neoplastic) effects of particulates have not been verified thus far by meaningful experimental models or available long-term epidemiological observations. Extensive long-term animal studies also have failed to demonstrate any non-neoplastic respiratory effect of diesel emissions, inhaled at particulate concentrations expected on our roads in the year 2000. Our current lower diesel penetration projections would reduce our earlier estimates of atmospheric particulate levels.

While a finite number of laboratory tests cannot prove that diesel exhaust will never have a health impact at any time, it may be concluded today that the weight of evidence from government and privately-sponsored research has shown no indication of an adverse health effect after four years of extensive testing. Based on the low contribution of diesel exhaust to ambient particulate levels compared to the high concentrations tested in most animal studies, the possibility that these particles will produce an effect which has not been discovered in these tests is remote. However, to ensure against the possibility that even a low level adverse health effect may exist, complex health effect studies are being continued. These studies will improve our understanding of the ability of normal physiological defense mechanisms to handle and inactivate even the smallest concentrations of the inhaled diesel particulate material and thus, increase our confidence that no significant effects will occur in the general public health.

AIR QUALITY EFFECTS

With respect to air quality , the diesel engine offers significant advantages for control of hydrocarbons (HC) and carbon monoxide (CO) emissions. HC levels of the total engine-fuel system are lower than a counterpart gasoline vehicle because the diesel vehicle has essentially no evaporative or refueling emissions. These lower HC emissions are beneficial in lowering ambient ozone. Furthermore, CO emissions of the diesel engine are inherently low and thus the replacement of a gasoline engine with a diesel will have a beneficial effect on ambient CO levels.

Increased dieselization is not expected to have an adverse effect on maintaining compliance with the National Ambient Air Quality Standard (NAAQS) for NO2. All areas of the country except Los Angeles and Denver are now in compliance with the NO2 NAAQS. (The Denver area has not had an NO2 violation for several years.) In addition, passenger car and light-duty truck diesel engines will have NOx emission levels below those of the vehicles they replace in the on-the-road fleet. It should also be pointed out that there is a large body of evidence showing that further reduction in vehicle NOx emissions is counterproductive, because such reductions will increase ozone formation in most urban areas (Attachment IV).

In contrast, dieselization of the light-duty fleet will have a small effect on Total Suspended Particulate (TSP) levels. Diesel vehicles, mainly heavy-duty trucks and buses, now only make a small contribution to this air quality problem. We estimate that trucks and buses currently contribute 1 to 3 micrograms per cubic meter to annual-average TSP levels in center-city areas. Most center-city TSP levels are 5 to 10 micrograms per cubic meter below the TSP NAAQS of 75 micrograms per cubic meter. (Respirable particulate accounts for 40-60% of the TSP in center-city locations.)

Assuming a total fleet dieselization as high as 15% of cars and light-duty trucks, which will not occur for many years, the ambient particulate increase will be small. Based on the lead-tracer model, we estimate that this level of dieselization will add less than 2 micrograms per cubic meter to ambient particulate in the year 2000, except for Los Angeles which is a unique situation. The increase in diesel particulate will be offset to a large degree by reductions in lead particulate from the gasoline vehicle fleet which will be converted to unleaded fuel over the same period of time. Thus, increased dieselization of the vehicle fleet is not projected to have a significant impact on the ability of non-attainment areas to achieve the NAAQS for TSP.

Potential diesel particulate effects on visibility is a subject that deserves serious consideration, since diesel particles are of a size that is especially effective in light extinction. The increased particulate levels estimated above, i.e., 1-2 micrograms per cubic meter, will cause a reduction in visibility; these visibility effects primarily will impact central city areas. If we take the lead particulate decreases into account and assume a 1% growth in vehicle miles traveled with no other changes, we can estimate that by the year 2000 visibility reductions may range from 3-7% for major U.S. cities, except for Los Angeles.

This estimate appears to disagree with a recent document from the National Academy of Sciences, (NAS) which estimated a 50% visibility reduction for Denver due to dieselization. Attachment V shows that the NAS estimate for Denver is erroneous by a factor of 14 which, when corrected, puts Denver well within the above range.

As mentioned previously, Los Angeles presents a unique situation because of its high vehicle density and poor atmospheric dispersion. The NAS document mentioned above estimated that increased particulate due to dieselization, which would not take place until the year 2005, could reduce Los Angeles visibility by as much as 20%. (The methodology used in the NAS report for the LA visibility estimates does not suffer from the same error as their Denver estimate mentioned above.) Our estimate for 15% light-duty dieselization and a particulate emission rate of .2 gpm results in a 13% visibility reduction for LA in the year 2000. Visibility in the Los Angeles area is already lower than most cities and it is the judgment of the California Air Resources Board (CARB) that these further visibility reductions may be objectionable. The CARB is currently considering possible regulatory remedies for this unique situation.

It must be emphasized that the previous projected effects of diesel particulates on visibility are based on an assumed dieselization of 15% of the passenger car and light duty fleets, emitting at a .2 gpm rate. As noted earlier, diesel penetration is now projected to occur more slowly than initial projections. Since visibility reductions are dependent upon total atmospheric particulate loadings, higher particulate emission levels could be acceptable at lower levels of diesel engine use. For example, a 0.4 gpm emission level at 7.5% penetration is comparable to .2 gpm and 15% penetration.

Therefore, although diesel particulate effects on visibility is a legitimate area of concern, the projected effects are not such that an immediate imposition of stringent particulate standards is required. Also, the projections are very dependent on emission and growth assumptions, requiring a continuing assessment to assure reasonable reliability of the projections. It is apparent that time is available to reassess the potential visibility impacts of diesel vehicles and to determine what would be the most effective control strategy, before deciding whether to implement further particulate emission controls.

DIESEL EMISSION TECHNOLOGY

Diesel engine emission technology development is being pursued in conjunction with the development of new engines and the refinement of existing designs. In general, it should be noted that lighter cars with smaller engines produce lower emission levels than heavier cars with larger engines. General Motors produces a full range of passenger cars and light duty trucks. The use of diesel engines in larger vehicles, of course, conserves the greatest amount of fuel, however, they also present the most difficult emission control problems.

From a HC and CO standpoint, the IDI diesel engine meets the existing light duty standards. The need to lower diesel HC emissions, however, becomes a critical factor in deciding whether or not the DI engine can be used in passenger cars. At the present time, the DI engine's emission rates exceed the current HC standard. Reductions in HC levels will be very difficult to achieve. Combustion system changes have not provided this capability to date. A catalytic converter used on gasoline cars to lower HC is not compatible with diesel exhaust due to low temperature of the exhaust and the presence of particulate matter, so this does not provide a ready means to reduce diesel HC emissions. Studies are underway to determine whether means can be found to reduce the DI engine's emissions and permit the use of this type of high efficiency diesel engine.

Techniques to control diesel NOx emissions are very limited and have major adverse effects. The most effective NOx control technology involves retarding injection timing and/or adding exhaust gas recirculation (EGR). Retarded timing reduces fuel economy, increases HC emissions and reduces power output. Thus, this is not a desirable control approach to use. EGR very effectively lowers NOx emissions and is currently used on our light duty engines. It also has some adverse effects, which depend on the amount of EGR used.

At low EGR levels such as are used in current engine systems, the effects do not signifcantly degrade engine performance and durability nor cause the engine to exceed other emission standards. High EGR rates, however, do cause severe problems. For example, on our 5.7 liter engine the level of EGR required to approach the 1 gpm passenger car NOx standard essentially causes the particulate emission rates to double. It also causes HC emissions to increase, degrades both fuel economy and driveability and can increase engine wear to the point that inadequate engine durability may result. At a 2 gpm NOx level all of these adverse impacts are eliminated.

Heavy duty diesel engine NOx control is even more difficult since use of EGR requires a very complex system. Many of our heavy duty diesel engines include a mechanical supercharger (Roots blower) as an integral part of the engine. Exhaust gas containing particulates fed into the inlet side of the blower can cause rapid wear and failure of this unit. On the other hand, routing EGR to the outlet side of the blower would require a metered variable pressure source of exhaust gas to counteract the blower pressure. This would add greatly to the complexity and cost of the EGR system and is not considered a practical approach.

Some have proposed the use of a NOx reducing catalyst similar to that used on gasoline engines. Such an approach is totally infeasible since a reducing catalyst requires that the exhaust gas contain almost no oxygen and the diesel engine exhaust inherently contains a very large amount of oxygen due to the nature of its combustion system.

With the limitations of NOx control technology, diesel NOx standards need to be established judiciously if we are to avoid the drastic adverse effects noted previously. The status of control technology suggests that the existing passenger car limits of 1 gpm and the 4 grams per brake horsepower-hour heavy duty standard being considered by the EPA both should be relaxed.

Three approaches are being pursued to reduce diesel particulate emissions: combustion system changes, modification of fuels and aftertreatment (trap) systems.

Changes in combustion chamber configuration and injection characteristics have lowered the particulate emissions from our passenger car engines significantly. When first introduced in 1978, the Oldsmobile 5.7L engine had a particulate emission rate of 0.8-1 gpm. By 1982, the particulate emission rate of that engine had been lowered to 0.4-0.5 gpm through combustion system improvements, a significant improvement, especially considering that the 1982 engine also met a more stringent 1.5 gpm NOx standard. Had we retained a 2 gpm NOx standard instead of 1.5 gpm, these particulate levels would have been still lower.

Although combustion system improvements are still being sought, it is not anticipated that further significant reductions in particulate emissions rates will result from this work. We appear to be approaching the point of diminisning returns.

Combustion system improvements which will reduce heavy duty diesel engine particulate emissions are also being sought. This development work is in a relatively early stage now. Improved fuel injection system control appears at this time to offer a limited reduction in particulates without other adverse effects. Additional work will establish the magnitude of improvement possible and an understanding of all of the design changes needed.

Heavy duty vehicle particulate emission rates will be reduced in the future even without improved control technology. Vehicle changes which improve fuel economy will have the side effect of lowering total particulate emissions also. Any change which reduces the horsepower required by the vehicle, such as radial tires, demand controlled cooling systems, driveline improvements and aerodynamic improvements will lower the particulate emissions which result from the vehicle performing a particular task. These improvements result from economic considerations related to the increased cost of fuel, so they can be expected to happen even if engine particulate standards are not made more stringent. These vehicle fuel economy improvements have been projected by DOT to approach 40%, when fully implemented on the in-use fleet.

We also have conducted extensive studies in conjunction with petroleum and additive manufacturing companies to try to find fuel modifications which will result in lower particulates. Preliminary results have shown the potential of reducing diesel particulates by up to 40% with changes in fuel composition and by up to 15% using fuel additives. A practical low particulate fuel, however, has not yet been identified.

In addition, further study is needed to evaluate the effectiveness of fuel changes on all types of diesel engines (light duty, heavy duty, IDI, DI, etc.). The costs and practicality of each potential fuel change must be determined by the petroleum companies and found to be reasonable before it could be considered viable.

Exhaust aftertreatment traps are also under development. Most of this work has been done on passenger car engines, though we have performed some limited testing of truck traps.

Many different materials have been found which are efficient in trapping particulates. More difficult is the requirement that the material must survive the regeneration process. Every one thousand miles a typical passenger car engine emits about 500 grams of very light, fluffy particulates. When this quantity of material is collected on a trap, frequent and efficient regeneration is mandatory.

Regeneration systems developed to date are complex and have not performed successfully on a repetitive basis. The process of burning diesel particulates requires temperatures over 900o F. Since diesel exhaust temperatures are normally far below this level, some means of raising the temperature is required. Many approaches have been tried, but none have been adequate to consider for production because of inadequate peformance, low reliability or excessive cost.

Regeneration of the trap involves burning the collected particulates, which have a substantial energy content. This process often raises the temperature of the trap well above the allowable limit of the materials used. Thus, the regeneration process often will cause the trap to crack or melt.

To date, our experimental trap systems (including the regeneration systems) have only been successful at low mileage. The highest test mileage we have achieved before failure on a car equipped with such a total system, has been less than 2000 miles. Thus, trap technology is not ready to consider as a production design and until better durability is demonstrated, it is impossible to project when, if ever, it might be.

In 1979, we successfully ran a car equipped with a experimental catalytic metal mesh-type trap for 34,100 miles before failure. However, loss of accumulated particulates and inadequate durability of the trap material (deformation and loss of trap material) precluded further development of this concept. This trap had many similarities to the Johnson-Matthey concept.

Perhaps our experience with the Johnson-Matthey trap system should be reviewed since some limited testing of this system on a small car has received considerable publicity recently. We have been working with Johnson-Matthey since 1980 to evalute and aid in the development of their trap system. We have tested 13 of their traps. Eight of them have been tested on a car provided by Johnson-Matthey. The highest mileage before failure we have recorded on any of these installations is 1290 miles. In addition, the regeneration system Johnson-Matthey provided for evaluation is among the most complex of any we have considered, and its use is limited to high speed driving.

We welcome the cooperation of Johnson-Matthey and others in working towards a solution to this difficult problem, but at the present time no one has come close to demonstrating a system which meets the requirements for customer use.

At this limited state of development, cost estimates are necessarily speculative. However, most trap systems we have tested would cost about $500 per car. This cost is well above the price increase that could be tolerated from the standpoint of its impact on the marketability of this engine option. The basic diesel engine is more expensive to produce than its gasoline counterpart and the significant trap system cost would price the engine above the value of its increased fuel economy in the eyes of many customers.

In summary, the particulate standards that now exist for passenger cars and light trucks and the standards proposed for heavy duty engines cannot now be achieved with existing technology. Fortunately, standards of this stringency are not necessary now. It is possible that traps, the least promising technology for control, may not ever be needed if improvements in combustion, fuels and vehicle fuel economy reduce particulate emissions enough to avoid adverse ambient effects.

Clearly time is available to improve technology and determine needed control levels.

LEGISLATIVE SIGNIFICANCE

The legislative deliberations now underway in Congress regarding the Clean Air Act are critical to the future of the diesel engine. Existing overly stringent emission standards should be modified so that the use of diesels is not precluded and experimental diesel engine development is not discouraged. The provisions of H.R. 5252 relative to the NOx and high altitude emission requirements for diesel engines would allow such further development.

In addition, it has been shown that the NOx emission requirements contained in this bill are adequate to assure that the nation will continue to meet its ambient air quality goal for nitrogen dioxide. With respect to the NOx emission contribution to acid rain, the relaxation of the NOx requirement for passenger car diesel engines would have an imperceptible effect, since total contribution by the motor vehicle fleet is less than 5%. Diesels are a small proportion of the total fleet. This conclusion is supported by an analysis provided to Representative Waxman in October, 1981, by Mr. Walter Barber, Director of EPA's Office of Air Quality Planning and Standards. Thus, there is no need for more stringent standards.

With respect to particulate emission requirements, the need for additional control appears to be sufficiently remote that there is time for EPA to develop more suitable innovative regulatory approaches than the "technology forcing" standards called for by the current regulations. This approach is neither appropriate nor cost effective.

It's a matter of record that GM has objected strenuously to the diesel particulate standards promulgated by EPA, on both technical and legal grounds. These challenges have been made through numerous submissions to EPA including a pending petition to suspend the 1985 standard of .2 gpm, as well as before the federal courts.

While there is much relevant information to be gleaned through an examination of that record, several points deserve emphasis. The present .2 gpm standard was issued by the Agency in an attempt to comply with the wrong statutory criteria. EPA acknowledged in promulgating this technology forcing standard that it was set:

"...to fulfill the greatest degree of emission reduction mandate of Section 202(a)(3)(A)(iii) of the Clean Air Act."

Although Congress established these criteria for heavy duty truck standards, EPA misused them as a basis for the light-duty vehicle standards, which include the infeasible .2 gpm 1985 standard. The U.S. Court of Appeals for the D.C. Circuit agreed that EPA had used the wrong criteria, saying,

"EPA cited the wrong section of the statute as authority for its rulemaking." Natural Resources Defense Council v. Costle, 655 F.2d 318,327 (D.C. Cir., 1981).

It seems clear that the .2 gpm level 1) represents a greater degree of stringency than Congress intended, because EPA misread the statute and 2) was based on an over-optimistic evaluation of then current technology, because neither trap-oxidizers and turbocharging -- the two technologies relied upon by the Agency in supporting their position -- provide the degree of particulates controls they were thought capable of supplying.

Consequently, we believe EPA has an obligation to correct the error of law which led to the excessive stringency of the standards, as an initial step, prior to setting standards based on the criteria of the proper source of statutory authority. As the Courts concluded, EPA has the authority to promulgate diesel particulate standards. However, that discretionary power should be guided by the criteria of Section 202(a)(2) of the Act, which does not require technology forcing levels.

EPA is at this time re-examining the feasibility of the standards and should be permitted to retain the flexibility to continue this effort. In fact, the Agency should be encouraged, as H.R. 5252 does, to explore alternative control strategies such as economic incentives, marketable offsets and averaging. might be especially appropriate and effective for the control of particulates.

If the current standards of .2 gpm particulates and 1 gpm NOx remain, GM will be forced to discontinue production of diesel passenger car and light-duty truck engines by the 1985 model year. A two-year delay in implementing the .2 gpm standard, which is now being considered in various legislative proposals, would not resolve this impasse. GM capacity for producing these units, which would be in jeopardy, totals approximately one million vehicles per year and, at full volume, involves employment of about 4500 people.

With respect to government research on diesel engines, General Motors believes that research on applications of technology is an appropriate function for the vehicle manufacturers. However, we believe that it is appropriate for government to fund research that will expand the basic engineering knowledge of diesel engine processes and enhance the long term development and application of diesel engines. Consistent with our previous comments (Attachment VI), government funded research could be appropriate in such areas as basic combustion, materials and health effects. The recently established Health Effects Institute, jointly funded by EPA and industry but independent of both, is the best available vehicle for health effects research.

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Dr. VOSTAL. In my present role at General Motors, I am responsible for a research laboratory with more than 60 professional and technical members involved in crash injury and environmental toxicology research. Among other programs, our department has been heavily involved in studying possible health effects from automobile emissions—particulary diesel particulates.

I welcome the opportunity to give you an updated view on the potential impact of the wider use of diesel engines in light-duty passenger vehicles in regard to public health.

The potential adverse human health effects from increased exposure to diesel particulates is a prime concern of increased dieselization. Some commentators have speculated that since ambient diesel particulate levels will increase and since they are respirable and have adsorbed on them potentially carcinogenic organic compounds, increased use of diesel engines may cause adverse human health effects. This view was supported by the EPA's report that organic solvent extracts of diesel particulates are mutagenic in bacterial assays such as the Ames test.

In contrast, the epidemiological studies of the British Medical Research Council conducted on London bus garage workers between 1955 and 1974 gave no indication that diesel exhaust material was a significant hazard as far as the frequency of lung cancer was concerned. This opinion was further supported by the recently published report of the National Research Council's Diesel Impacts Study Committee, which found no basis for concluding that dieselization of a portion of the U.S. fleet would pose a lung cancer hazard, or that particulate mass emission rates for diesel-powered cars should be further reduced.

Studies were initiated at General Motors Research Laboratories in 1978 with the intention of finding a plausible explanation for the apparent discrepancy between the results of short-term assays of diesel particle extracts and the results of epidemiological studies.

The results have indicated so far that, first, the data obtained using organic solvent extracts of diesel particles were of little predictive value for health assessment. This is probably due to the fact that the bioavailability of the adsorbed compounds—solubility in biological fluids—is only a fraction of that obtained using organic solvents which are not present in living tissues.

Second, the physiological defense mechanisms of the respiratory system were found effective in rapidly clearing the deposited diesel particles from the pulmonary epithelium. Apparently these defense mechanisms are capable of neutralizing the biological aggressivity of the hydrocarbons adsorbed on the surface of the particulate matter.

Third, the amounts of diesel particulate deposited and retained in the respiratory system at expected ambient concentrations were assessed to be far below the dose levels required to produce biochemical or immunological effects in living organisms.

It may be concluded, therefore, that in spite of the theoretically predicted carcinogenic properties of the particulates, no definitive evidence has yet been found to implicate diesel emissions as a threat to public health, at the maximum market penetration we earlier projected for light-duty vehicles, as it has been shown and presented in Dr. Mark's presentation.

Thank you.

[The prepared statement of Dr. Vostal follows:]

PREPARED STATEMENT OF DR. JARO J. VOSTAL

Good morning. I am Dr. Jaro J. Vostal, Head of the Biomedical Science Department of the General Motors Research Laboratories at Warren, Michigan, I have obtained my degree in medicine from Charles University, Prague, Czechoslovakia, in 1951 and my Ph. D. degree in Industrial and Environmental Toxicology in 1961, also in Europe. Prior to joining General Motors in 1974, I was on the faculty of the University of Rochester School of Medicine, New York, in the Department of Preventative Medicine, Pharmacology and Toxicology, Thus, I have spent the largest portion of 25 years of my professional career on research and teaching environmental health and toxicology.

In my present role at General Motors, I am responsible for a research laboratory with more than 60 professional and technical members involved in crash injury and environmental toxicology research.

Among other programs, our department has been heavily involved in studying possible health effects from automobile emissions—particularly diesel particulates.

I welcome the opportunity to give you an updated view little more detail on the potential impact of the wider use of diesel engines in light-duty passenger vehicles in regard to public health.

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Mr. **GORE**. Thank you very much.

Dr. **MARKS**. If you would like, Mr. Dimick can give a brief summary of our technology and its development in our view of where we stand on the various aspects of reducing diesel emissions.

Mr. **GORE**. If you could summarize that, Mr. Dimick, please proceed.

Mr. **DIMICK**. I would like to very briefly cover for you our status with regard to development of diesel engines to meet future emissions standards. I would like to point, out to begin with, that GM adopted diesels first in large cars and light-duty trucks because it is here that the engine provides the greatest fuel savings. Unfortunately, this causes us to have higher emission levels and a more difficult control problem compared to those utilizing diesels in small cars.

Let me discuss the emissions from the diesel engine one at a time.

First, with regard to hydrocarbons, the diesel has inherently low HC emission levels. While the gasoline engine requires a catalytic converter in order to control HC to today's standards, today's diesel engine meets these standards without any aftertreatment device. Our only concern with regard to the HC standard relates to our ability to meet today's standards with a more advanced direct injection diesel which we are currently developing for potential use in passenger cars. At the present time this engine cannot meet the current HC standard. We would like to use this engine for passenger cars because it provides an additional 15 percent in fuel economy improvement compared to the indirect injection-type engine currently used in our passenger cars.

Let me next mention carbon monoxide, CO. Diesel engines inherently also have low CO levels due to the fact that the engine runs with excess air in the combustion process. We do not anticipate any concerns with CO from the diesel.

Let me next discuss oxides of nitrogen, emission levels. We have evaluated a great number of alternative techniques for NOX control. Of these, exhaust gas recirculation has been selected as the only one allowing significant reduction in NOX levels. We currently use EGR to meet the 1.5 gm/mi NOX standard with our Olds diesel engine. Our concern regarding the 1985 1 gm/mi standard for NOX is the high EGR rates that will be required. These increased levels of EGR will double particulate emissions, increase HC emissions, degrade fuel economy and driveability, and increase engine wear. Because of these adverse impacts, GM is seeking relief from the 1985 1 gm/mi standard.

Let me next cover particulate emissions. We have an incentive to reduce these emissions apart from the regulatory requirements imposed by the EPA. One reason is that our customers find visible smoke objectionable. Further, the particulates get into the engine oil and cause us to change the oil more often on our diesel engines.

Three approaches have been pursued to reduce particulate emissions. The first approach we have been pursuing to reduce particulates has been through modification of the engine hardware. We have been through over 3,000 configurations in arriving at today's Oldsmobile engine. We feel our engine has the lowest emission level for its size that has been achieved. Our 5.7L Olds engine, when introduced in 1978, had 0.8 to 1 gm/mi levels. In 1982, we have cut these levels in half. Although combustion system improvements are still being investigated, it is doubtful that further significant reductions will result from this work.

We have also conducted extensive studies in cooperation with the petroleum and additive companies to try to find fuel modifications which will result in lower particulates. We have tested fuels which have given up to 40 percent reduction in particulates. However, a practical low particulate fuel which could be furnished by the oil companies has not yet been identified.

The last area we have worked on extensively for particulate control is the use of an aftertreatment device; we call these traps. We have found many different materials which will efficiently trap particulates. The problem is that we must regenerate; that is, periodically burn the particulates off the trap. This requires exhaust temperatures over 900° F, far above normal exhaust temperatures.

Further, due to the fact that the particulates are themselves a fuel, the temperature on the trap rises to much higher levels, often well above the limit of the trap material used. Thus the regeneration will often cause the trap to crack or melt. To date, our experimental trap systems have only been successful at low mileage, and an acceptable regeneration system has not been identified.

For example, we have been testing the Johnson-Matthey trap system since 1980. We have tested 13 of their traps. Eight of them were installed on a car provided by Johnson-Matthey. The highest mileage we have recorded on any of these installations before failure is 1,290 miles. Further, the regeneration system which they have provided would not be usable in customer service.

We welcome the cooperation of Johnson-Matthey, Corning, Texaco, and other suppliers who are working with us toward a solution to this difficult problem, but at the present time we have not come close to demonstrating a system that meets the requirements for customer use.

A further concern that was mentioned earlier is the added cost to the customer of a trap system. We have made a production cost estimate on several experimental trap systems we have tested and they would cost about $500 per car. As Dr. Marks mentioned earlier, this would increase the option price of the engine above the value of its increased fuel economy to the customer.

In summary, I have concentrated on the problem of 1985 emission standards for passenger cars. A similar status exists in the technology for meeting future standards for trucks. At the present time, no technology is ready for application to meet the 1985 NOX and particulate standards for our GM-produced diesel engines.

Mr. **Gore**. Thank you very much.

I would like to make an adjustment and adopt the 5-minute rule, because I think Mr. Shamansky is on a time schedule. We will go for as many rounds as is necessary.

Mr. Walker?

Mr. **Walker**. First, Mr. Chairman, as I understand the convention on several occasions today, I would ask unanimous consent to include in the record the GM petition to EPA to suspend the revised 1985 to go with the legal analysis concerning the notice required.

Mr. **Gore**. Without objection.

Mr. **Walker**. You mentioned that much of your work has been done on the large engines because you decided to go to them first. If you were to develop smaller engines in the diesel area, can we assume that the problems that you faced were technology related—I don't suppose that that is the health standard side of it very much—but with regard to technology, would your problems be substantially reduced by going to smaller diesels?

Dr. MARKS. The ability of engines to meet the particulate standard is very much dependent on engine size, or really vehicle size. It is the weight of the vehicle. And of course, smaller engines go with lighter weight vehicles, so it is certainly true that the heavier vehicles tend to produce larger amounts of particulate and require larger degrees of control.

And that is something we buy when we buy the additional fuel economy, fuel conservation of those larger engines.

Mr. WALKER. I am at a loss to understand the reasoning behind the larger vehicle decision when you say that it was because you get a far more significant economy out of the larger vehicle than out of the smaller vehicle. It seems to me that the rate of savings is about the same. In the heavier cars, you go from 17 to 26 miles a gallon by going to diesel. In the Volkswagen, they go from about 26 miles to the gallon to 41 miles per gallon.

It seems that is relatively the same in terms of EPA gasoline versus diesel standards, isn't it?

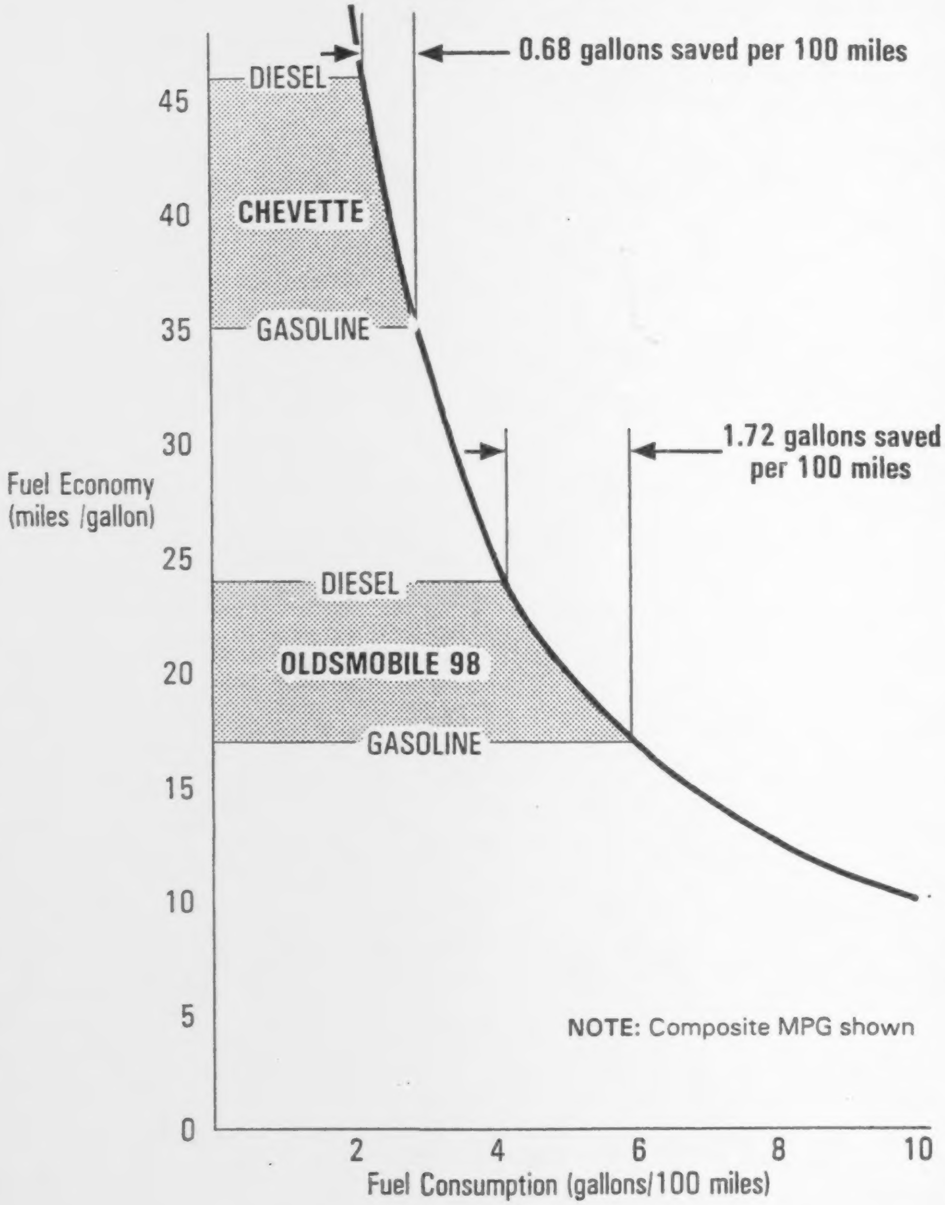
[Information follows:]

We believe the attached figure helps to explain our decision to apply diesel engines to larger vehicles first. This figure illustrates the inverse relationship between fuel economy, in miles per gallon, and fuel consumption, in gallons of fuel per vehicle miles traveled (in this instance, per 100 miles). In addition, EPA Composite Fuel Economy data for a 1978 Oldsmobile 98, the passenger car model in which General Motors first offered a diesel engine, and a 1982 Chevette are shown. Data for both gasoline and diesel versions of these two models are plotted, indicating the differences in fuel economy and fuel consumption between the two vehicles.

As can be seen the percentage improvement in fuel economy is about the same for both vehicles. However, the resulting decrease in fuel consumed per 100 miles of vehicle travel is 2.5 times as large for the larger Oldsmobile vehicle. Because of the inverse relationship between fuel economy and fuel comsumption, similar improvements in fuel economy translate into much larger savings in fuel consumed for the larger vehicle, assuming an equivalent number of vehicle miles travelled. This factor, the resulting decrease in fuel consumed, was an important consideration in the decision to apply diesel engines to larger vehicles first.

Fuel Economy and Fuel Consumption

DIESEL VS. GASOLINE



Dr. Marks. The percentage increase in fuel economy is about the same on large and small vehicles. The fact that the larger vehicle uses much more fuel because it is at a lower fuel economy level means that the total gallons of fuel that you save is much larger on a heavier car. That therefore justifies the added cost.

Mr. Walker. It has nothing to do with the efficiency of the powerplant, that is relatively the same in both the savings to the consumer is considerably difficult, providing in fact throughout the additional cost of putting the technology into the vehicle?

Dr. Marks. Exactly.

Mr. Walker. I am interested in the fact that in your statement, Mr. Dimick, with regard to the Johnson-Matthey tests that you have run, principally because that is the one that has been thrown up to the subcommittee normally as being kind of the advanced state of the art at the present time, do I understand correctly that at this point you have not been able to run a vehicle using it on a—I guess one of your heavier cars, you have been unable to run that vehicle for not more than 1300 miles?

Mr. Dimick. That's correct.

Mr. Walker. Why has the system failed normally?

Mr. Dimick. In most cases we have found that it is due to overheating. Now, it is a very difficult—I won't say very difficult, but the configuration for our trap is different than that which is used on a smaller vehicle. The mesh that they use in that trap is much denser and we require a higher efficiency trap because our engine output is higher. That may account for those differences.

Mr. Walker. In other words, you are saying that you have no reason to doubt the fact that a VW may have gone 50,000 miles on a trap, but that that is not necessarily technology that immediately transfers over to heavier vehicles?

Mr. Dimick. Yes.

Dr. Marks. Part of it. The other part is that even on the small vehicle it has to be demonstrated that that such a trap will survive under high speed operation conditions.

Mr. Walker. The national speed limit is 55, so I would be reluctant to say someone would operate it above 55 miles an hour. Everyone knows no one does that in the country. Are you saying that sustained speeds of 55 would be a problem even in the small engines?

Dr. Marks. We haven't demonstrated that the trap can survive under sustained operating conditions at 55 miles an hour.

Mr. Walker. Thank you, Mr. Chairman.

Mr. Gore. Mr. Shamansky?

Mr. Shamansky. Thank you, Mr. Chairman. I drive here in Washington a 1980 Cadillac Seville. It is often noticeable that I am on the road. I feel I am a bad citizen when I do it. At home this January, when the temperature got low, there wasn't even a connection that I could plug it in to heat it up, so I kept having to tow it. It was a problem for me.

We will take that up later, you know.

Mr. Walker. Next time, they will send the consumer sex.

Mr. Shamansky. I thought while we are at it, folks, I wanted a testimonial of sorts. I am the author of something called the Automobile Research Competition Act, which I submitted here and Senator Stevens, the majority whip in the Senate, and that is to develop a competition for American enterprise, not just automobile companies, could develop a car based on the projections of the University of Columbus to have an automobile to carry four passengers with a diesel engine at 100 to 85 miles per gallon of gasoline.

Does your work so far indicate that on a car that would, say, weigh about 1,000 pounds that you develop a diesel. Have you determined what the maximum mileage might be?

Dr. **Marks.** I guess I don't believe that I could answer that there is a maximum fuel economy for a given size vehicle. The diesel typically, as we have said, gives us about a 25 percent, and in some cases under certain driving conditions, even larger fuel economy improvement. But to extrapolate that to very, very small vehicles, and I say——

Mr. **Shamansky.** I am talking about four passengers.

Mr. **Marks.** 1,000 pounds is a very, very small vehicle.

Mr. **Shamansky.** In terms of weight.

Dr. **Marks.** I must say that I just don't have any experience with that. I am sorry.

Mr. **Shamansky.** Are you at all familiar with any work being done with respect to ceramic components in say, diesels?

Dr. **Marks.** Yes. We have research work going on in that are, and we are aware that others are working in that area also.

Mr. **Shamansky.** My understanding of it is that the use of ceramic parts might permit much higher temperatures, as you talk about the problem of heat at 900° F., if it could go to 3,000° F., am I correct in thinking that you would burn up most of the pollution if not all of it?

Dr. **Marks.** I guess we have not seen any evidence that that would be the case, but our work with ceramics has been relatively limited at this point. I think that the problem of diesel particulate formation in the combustion chamber is due to the type of combustion that takes place in a diesel engine. Holding temperatures high enough to incinerate those particles in the exhaust stream—if you had materials that would do that—is just one part of the problem. The other part would be the duration of time that they are at those temperatures. To be able to speculate at this point that they would be at that temperature—a high enough temperature—long enough to burn up in the exhaust is really not possible, you see, when they are on a trap they are there and they burn until they are gone, but to predict they would burn as they pass through an exhaust system that is at that temperature would be speculative.

Mr. **Shamansky.** I am not suggesting industrial espionage, but are you familiar with any other companies in your field working on this?

Dr. **Marks.** The trade publications have indicated that they are working in that field as well as others, and that is all we really know.

Mr. **Shamansky.** Do you have any idea whether the trade publications indicate the mileage and the capacity?

Dr. **Marks.** I am not aware of it.

Mr. **Dimick.** We are doing a limited amount of work with ceramics, and I think the thing that has to be brought out here is that the ceramics probably will increase exhaust temperature. You save energy by not putting it into the cooling water, but most of that energy goes out the exhaust. The Cummins approach uses that by putting hardware in the exhaust which they call turbocompounding to utilize the energy and put it back into the engine.

Professor Sawyer commented earlier trying to apply that technology to passenger cars is pretty complex and you are going to see that type of thing in larger vehicles first.

Mr. GORE. The gentleman's time has expired.

First of all, we invited the Cummins expert to testify on this matter, but he was out of the country and could not attend this hearing. My colleague, Mr. Shamansky, has this bill in that has been motivated as I understand it, by a concern that the research on new technology vehicles being done in foreign countries seems more impressive than that done here in the United States, and I think the legislation is really designed to organize a competition here in the United States to get things moving.

You all are from the largest automobile company in our country, and why is it that the Japanese would have a ceramic engine in a vehicle being tested on the road—I believe that is the case, isn't it—yes—and yet our largest company does not?

Dr. MARKS. I think Mr. Dimick probably has more information about that than I have.

Mr. DIMICK. The engine that we are aware of that ran was primarily an engine that was sponsored by a ceramic vendor, so I think we are talking about an attempt by Kyoto Ceramics in this case to try and sponsor a new product technology with ceramic use in engines. We are well aware of those efforts, but I think it is a product trying to be sold by a vendor that you are seeing expressed in that engine.

Mr. GORE. I guess I am asking a larger question than that, and I am sure that you all have responded to the larger question that I am trying to articulate many times in the past, but Americans are troubled that our auto companies don't seem to have the pizzaz in research and development that the foreign manufacturers keep springing on us. I can only speculate at the emotional reaction you have to a question like that, because I know it has been asked before on many occasions, but how do you respond, Dr. Marks?

[The information follows:]

General Motors research and development activities continue to play a leading role in the development of significant automotive technological advances. This can be illustrated by two facts.

First, GM licenses, without great publicity, other automobile manufacturers, including many Japanese manufacturers, to use its inventions. Some of the major examples are: (a) the energy absorbing steering column; (b) exhaust gas recirculating system; (c) temperature controlled air cleaners; (d) charcoal canister evaporation control systems; (e) aira injection systems; (f) catalytic converter designs.

Second, some foreign manufacturers have looked to GM designs as a solution to their own technological limitations, in some instances independent of licensing procedures. For example, see *General Motors Corporation* v. *Toyota Motor Company, LTD, et al.*, 467 F. Supp. 1142 (U.S. District Court, S.D. Ohio, W.D., 1979).

In the Toyota case, the findings of the District Court were confirmed subsequently by the U.S. Court of Appeals for the Sixth Circuit, December 3, 1981, *General Motors Corporation* v. *Toyota Motor Company LTD, et al.*, 212 USPQ 659 (1981), cert, denied April 19, 1982. The Supreme Court has declined to review the Court of Appeals ruling in favor of General Motors.

The District Court found that Toyota's initial research into catalytic converters was not as productive as that done by General Motors. The results of the Toyota testing program in late 1971-early 1972 were very disappointing; prototype converters regularly ruptured or sagged when they sere subjected to high temperatures. At an EPA public hearing in Washington, D. C. on April 17, 1972, a Toyota representative made a detailed sketch of the General Motors catalytic converter design shown as part of our presentation that day, which was subequently delivered to Toyota's converter research group in Japan. Toyota constructed a catalytic converter which contained all of the essential elements of the General Motors patented design, in slightly modified form, which design proved satisfactory and was subsequently put into production. Thus, by June 1973, Toyota was able to report to the EPA that the company had solved most of the catalytic converter problems which had confronted it only one year earlier.

Dr. MARKS. I guess, Mr. Chairman, we tend to think of our technology in different terms than you have indicated. In particular, I think General Motors' technology in this area of emission control is a good example of very advanced technology. It is technology which we put across the board in our automobiles in 1981 to control engine functions very precisely and maintain the right conditions to get our cars to the very stringent emission requirements and at the same time not suffer much in fuel economy loss.

As a result of that, for instance, we are the world's largest manufacturer of microprocessors in the world. Some of the technology I think that is in our cars tends to become thought of less than spectacularly, if I could use that word, simply because it is so ubiquitous. When we do it there is a lot of it out there and it automatically becomes a state of the art.

Mr. GORE. Are you still selling more cars than Bally is selling Pac Man's? Are you still the eight-bit processor?

Dr. MARKS. I think that is true. For instance, the self-diagnostic capability of that equipment is just not really talked about very much, but the fact that we have been able to put that into the field and it hasn't had a lot of problems that many people thought it would, I think is a very remarkable achievement.

Mr. GORE. Well, I will take your response, but for whatever it is worth, and I know this is not the first time you have heard it, as you confront elected representatives of the people in this country I am telling you people in this country are restless and disappointed. Maybe they don't have a right to be, but that is the perception.

I know people in your company are aware of that and redoubling efforts to move forward.

Mr. SHAMANSKY. Mr. Dimick, I did not understand your response when you said that the ceramic thing was developed by a vendor and then just dismissed it. I mean, is that some kind of persuasive answer that oh, well, it was just from a vendor? Everything is from a vendor, not someone selling something. The question is, why aren't you buying? If you can't develop it yourself, why aren't you encouraging someone else to provide that?

Mr. DIMICK. We are buying parts from Kyoto Ceramics and running them in engines. I didn't mean to imply we were not. I was trying to explain why that product demonstration and the public release on it came in this case, from Japan rather than the United States.

Mr. SHAMANSKY. I have to leave, and I appreciate the chairman permitting me to do this. I have two GM cars, one in Colombus and one here. I grew up in an age in which American was the best and Japanese was junky, as we used to say. When I was in college, I learned that a colonial economy was one in which they shipped raw materials overseas and then imported finished goods.

So see General Motors somehow or other looking to the Japanese in the automobile field is not in any way to denigrate the Japanese. It worries me about General Motors. I don't know what the explanation is. I am just a disappointed flag waver, I guess, on that, and this competition that I have submitted, proposed, is where the private sector would put the money up first.

Dr. MARKS. If I could respond to that——

Mr. SHAMANSKY. Sure.

Dr. MARKS. I think the development of technology is taking place all over the world, and it is true that Japan is more recently into the automobile business and has become very keen competitors, and they are doing good research in this area. I don't think that it is unusual to see us looking to them as suppliers as we do to suppliers in this country, and in this case——

Mr. SHAMANSKY. Certainly if they have a better product, you should certainly look to them. I think that is absolutley logical.

Dr. MARKS. And we do look to our vendors all over the world for developments of this sort. It is not to say that we aren't doing that kind of research ourselves and have our own competitive products to evaluate alongside of these vendor products. That is going on and I want to assure you that it is.

Mr. SHAMANSKY. Thank you, Mr. Chairman.

Mr. GORE. My time has expired. Let me ask whether you all have taken a position on Mr. Shamansky's bill. Has that been run through the mill yet at GM?

[The information follows:]

Each automotive requirement of the bill appears desirable in itself; however, whether these requirements result in a technically feasible or salable vehicle is difficult to determine.

Assuming that the bill's requirements are listed in the order of priority, the fuel economy cirtieria could only be met with a vehicle mass considerably below today's lightest production vehicles. Some compromise in the bill's requirements as to the number of passengers and environmental or safety requirements would probably be necessary to achieve the required vehicle mass.

While Gneral Motors agrees with the bill's intent to spur energy conservation, the price of fuel would determine if such a vehicle is salable. It is our belief that the marketplace defines future product designs more effectively than legislation.

Dr. MARKS. I am not aware of that.

Mr. GORE. I see your colleague there indicating that that has not been done. In the interest of keeping a balanced record, after the insertion of the General Motors petition, without objection I would like to insert the response to that petition by NRDC.

I recognize again Mr. Walker.

Mr. WALKER. Can you give us some idea, since we are worried about innovative research in some of these areas, can you give us an idea how much of the research dollar GM spends is driven by technology forcing regulation from the Federal Government?

Dr. MARKS. I guess the best way to respond to that is that we have very large expenditures for research and development in this area of emission control devices. Those figures—I haven't them at my fingertips, but I would be glad to supply them.

[The information follows:]

Because expenditure records are kept for other purposes and may not directly apply to the question, an answer is not readily available. General Motors has developed data which indicate the Corporation's expenditures for "research and engineering" effort, but not precisely for such work that is "driven by technology forcing regulation."

However, our understanding of the two areas in question indicates that they are both relatively alike, and that the data which follows respond to the question asked.

For the year 1980—the most recent year for which complete expenditure reports have been processed in this respect—the data show:

	Millions
Automotive safety research and engineering	$168
Automotive emission control research and engineering	254
Total	422

These expenditures have included some work that might not be considered to be "driven" by technology forcing regulations. On the other hand, there have been very few years in the last 12 when the Corporate effort has not been mandated preponderantly by the need to meet constantly changing standards, with too little lead time for normal research and engineering practices, in both product and manufacturing development. In the absence of the opportunity to optimize our control systems to provide maximum fuel economy, driveability, and performance, as well as to minimize cost to the consumer, we interpret these operating conditions as "technology forcing" in a very real sense.

Mr. **Walker**. I am thinking also in the safety area, and other things, that when we begin talking about the fact that GM may not have been as innovative in recent history as they were in the past, I think we also have to look at the fact that we were forcing your research in particular directions out of this place here without very much of a consideration what it was doing to your ability to innovate, and that in fact at times it seems to me that we didn't even put very much thought into the direction in which we were forcing the industry.

Now, of course, your overseas competition had to meet some of that, too, but the fact is that if they have a product that is innovative, but they don't particularly want to sell in this market, they have other markets for it, and many of our competitors are selling vehicles overseas that they don't sell here that have innovations in them but can't be sold here because they don't meet the standards that Congress has forced on you for this marketplace; isn't that true?

Dr. **Marks**. Yes. Another aspect of this is, of course, that the development work that has been necessary to meet the emission standards and other regulatory requirements has been added on top of the requirement of the marketplace which has been to completely redesign our entire product line in the last couple of years. That additional burden, of course, is not on foreign manufacturers who happen to be in that part of the market already. Their products were at the small end of the market, and that requirement isn't there for them. So I think it is true that the total demand upon the research and developments efforts and product development efforts of the U.S. manufacturers has ended up to be larger.

Mr. **Walker**. Somehow, I would think it has to be somewhat of a concern to you to see that as fuel prices have gone down a little bit, the American buyer has gone back to precisely the kind of vehicles that we are telling you not to build, isn't that true?

Dr. **Marks**. That is a concern because the demand for larger cars and higher performance cars has been very evident in just the last few months.

Mr. **Walker**. The decision, however, that you have made with regard—I referred to it before, that I have seen in some automotive publications, that you have made with regard to smaller diesels, does that mean that really that you are not looking toward the market of what many people talk about as being a possibility of the 100-mile-per-gallon automobile? There has been some speculation in foreign marketplaces or in foreign publications that they may indeed be developing two- and three-cylinder diesels and lightweight vehicles that can achieve 100 miles a gallon kinds of capabilities.

It seems to me that GM seems to be backing away from that kind of a development role. Is that a fair assumption?

Dr. **Marks**. No, I don't think that is a good assumption, Mr. Walker. We have continuing developments in our engineering staff of a wide range of vehicles which go down to very, very small vehicles and we have lightweight vehicles. The question of whether that moves from the staff operations into an operating division and whether we produce those vehicles, of course, is going to be dependent upon the marketplace.

I think we have seen a growing recognition that lightweight vehicles do not fare as well from a safety standpoint as heavier vehicles, and that understanding, I believe, is going to be of more concern to people. That issue was raised earlier in these hearings, and I just would comment that we ought not to restrict ourselves just to the two-car collision where a larger car meets a small car.

It is true that if a large car meets a car say half its weight, the prospects of fatalities are about 8 to 1 in favor of the occupants of the large car. But also in just a single car collision, a collision from a car running off the road into a bridge abutment, that a 2 to 1 factor in weight also results in about a 2 to 1 ratio of fatalities, so that is a concern to people. I think going to very, very light-weight automobiles is a question that needs to be addressed in that framework in this country.

Mr. **Walker**. Of course, there has been a long debate going back over 20 years as the relative safety merits. There is a debate as to whether or not the lighter weight, more maneuverable vehicle isn't capable of avoiding accidents, too, and that has to be entered into the calculation. There is a longstanding debate over the merits of lighter weight versus heavier weight vehicles.

Dr. **Marks**. The data that I gave you was simply looking at the existing record in the field of lightweight and small vehicles, not a calculation based upon physics.

Mr. **Gore**. The Wall Street Journal reported recently that once again the Japanese appear to be leading us with respect to everyone on safety of lightweight vehicles, and may come up with a breakthrough in that area. What kind of research—you mentioned this 2 to 1 ratio. That is not a fixed coefficient. It could be changed with a breakthrough in safety design and so forth. What kind of research—are you satisfied with the extent of research being done on that at GM?

Dr. **Marks**. There is a strong effort to make sure that all of our vehicles meet minimum safety requirements; whatever those—the—have the highest degree of safety that you can. The fact is, of course——

Mr. **Gore**. Well, there is a difference between the two, meeting minimum safety requirements and getting the highest degree that you can, but go ahead.

Dr. **Marks**. I misspoke.

Mr. **Gore**. I did that once myself.

Dr. **Marks**. Our vehicles all meet the safety requirements, obviously, of the standards. We do make every effort to see that we meet our own standards in addition is what I meant to say. We look at vehicles and say what can be done to make those vehicles more safe? I am not aware of anything that is going on anywhere else, Japan included, that I think would be any more impressive to you than if we could take you and show you all of the things that we are doing in the safety field.

We are very serious about that effort, and the evidence is in our products in the field. If you look at the published statistics in the field, the Japanese products today and our products today in the same weight classes, our products are doing better in terms of statistics than any of the Japanese products.

Mr. **Gore**. I am not talking about ones in the field. I think that there is strong evidence on that point. But the Wall Street Journal indicated that the Japanese effort there is more impressive by a good bit than that in the United States I hope they are wrong about that, but I can just tell you that the market for safety improvements in lightweight vehicles is a substantial one.

I mean, I get grief from my wife about driving a lightweight vehicle in Tennessee when I am traveling around my district, and she is concerned as are many people in this country, about the safety of those vehicles, and I am just telling you that if I came up in a couple of years on the decision to replace that vehicle with another lightweight because of the conversations that I have had with my wife and because of the concerns that I have just on my own, I would be looking very much—if there was a vehicle there that had substantial advantages in the area of safety, even if they cost more, I am telling you, I would buy that vehicle and there are millions of people in that same category, and whichever company comes up with a dramatic breakthrough on safety in lightweight vehicles, you are going to see a big dent in the marketplace.

If the Japanese are in front in that area, I am unhappy about that, but as I say, I hope they are wrong.

Dr. **Marks**. We recognize that that is a very competitive area and are certainly pursuing it aggressively. If you wear your safety belt in that small car you are much safer than if not wearing that safety belt in the large car.

Mr. **Walker**. No questions. I hope if my son meets up with Shamanasky's Seville I am properly protected.

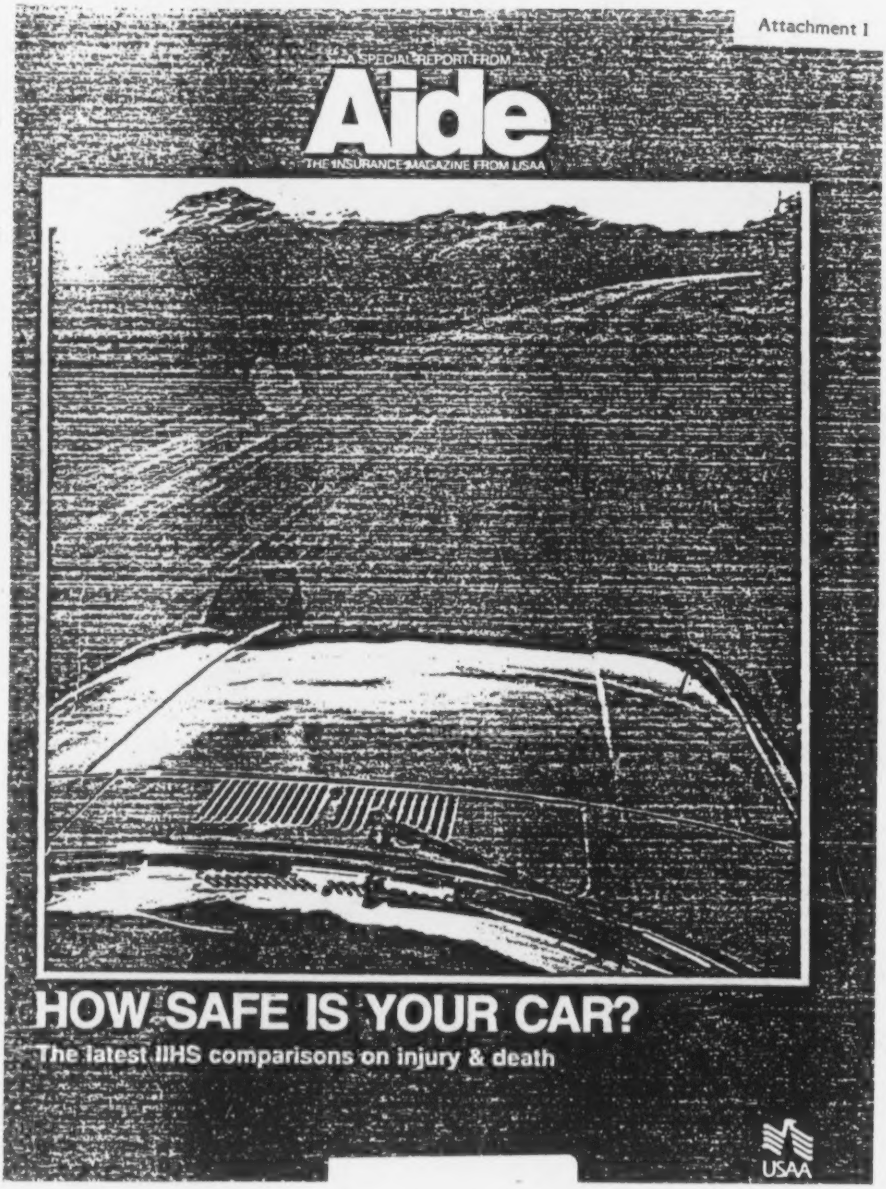
Mr. **Gore**. Could you supply those statistics you referred to on the Japanese versus American safety figures for the record?

Dr. **Marks**. Yes; we would be glad to.

[The information follows:]

Statistics on the relative fatality and injury rates of small cars versus large cars and American cars versus Japanese cars are given in Attachments I, II and III. These data are based on insurance injury claim experience for various model vehicles.

Attachment I



A SPECIAL REPORT FROM

Aide

THE INSURANCE MAGAZINE FROM USAA

HOW SAFE IS YOUR CAR?

The latest IIHS comparisons on injury & death

USAA

DIAGNOSIS: DEADLY & DISABLING

- **One of every 50 Americans will be injured this year in a motor vehicle collision.**
- **Crashes kill 1000 Americans every week on the average.**
- **Motor vehicle injuries are a major health problem, second only to cancer in economic burden ($20 billion annually).**
- **The burden of motor vehicle injuries falls heaviest on younger Americans, while other leading health impairments (cancer, heart disease and stroke) are concentrated in older age groups.**
- **One of every five child deaths and more than half of all serious childhood injuries are due to motor vehicles (46,000 one- to four-year-olds are seriously injured annually).**
- **You are more likely to die or be injured in a crash in a small car than in a large car.**
- **Your chances of being killed in a Japanese-made car, in general, are greater than in a small, American-built car.**

USAA

FROM THE PRESIDENT

When an airliner crashes and all the passengers are killed, it makes headlines for days, sometimes weeks. And there is no question that such a crash is a major tragedy. However, more people die in a single day in automobile crashes than die in a major airline disaster! Yet few of us consciously consider the risk we take each time we get into an automobile.

The severity of the problem of automobile injuries and deaths cannot be overemphasized. But human nature seems to be such that people will never drive as safely as they should. And even if most did, there would always be enough drunks and speedsters on the road to ensure that crashes would still happen.

Because all crashes cannot be prevented (although we should keep trying), it seems particularly important to do all we can to make automobiles more crashworthy. By crashworthy, I mean able to protect occupants from serious injuries and deaths if a crash does occur.

We've written to you in *Aide* Magazine before about the importance of making cars more damage resistant and less expensive to repair, so that costs such as collision insurance premiums can be controlled. But human lives and safety are even more important.

For this reason, I feel it is vital to share with you some study results released recently by the Insurance Institute for Highway Safety (IIHS) and its companion organization, the Highway Loss Data Institute (HLDI). These studies are based on *actual* automobile crashes involving injuries and deaths. They reveal some significant differences in the crashworthiness of the most common makes and models of cars.

It will come as no surprise to anyone that these studies show small cars to be generally less crashworthy than large cars. This has been widely known for some time. Yet we all can see that small cars are here to stay because they have a number of advantages such as energy efficiency.

USAA is not suggesting that people stay with large cars just because they are more crashworthy. Instead, we hope people will give crashworthiness more consideration when they select a car, whatever size it may be. Further, we hope manufacturers of small cars will give more emphasis to safety in the design of their cars in the future.

The information in this report and the conclusions drawn are those of IIHS and HLDI. While USAA contributes its claims data to these organizations, the results of this report have a much broader base of data than any one insurance company could ever collect alone. For this reason, and because of the well-established integrity of IIHS and HLDI, we have great confidence in the information they produce.

Most USAA members are concerned about safety and are careful shoppers who thoroughly research their buying decisions. I also know that Association members are concerned about the public good and are willing to do their part to influence change where it is needed. Because of this, I feel it is USAA's responsibility to share this information with you — not to persuade you to buy any particular kind of car, but to give you information to consider the next time you buy a car.

Robert F. McDermott

ROBERT F. McDERMOTT
President, USAA

A report from the
Insurance Institute for Highway Safety

HOW SAFE IS YOUR CAR?

by William Haddon, Jr., M.D.

Highway crash losses pose a serious national problem that shows every sign of continuing to worsen. The latest studies by the Insurance Institute for Highway Safety (IIHS) and the Highway Loss Data Institute (HLDI) indicate that there are wide variations in the injury experience of different kinds of motor vehicles on the highways. These variations show up even among vehicles of the same size, body style and price range. Of course, the most obvious differences relate to car sizes.

For years, researchers have known that occupants of small cars suffer especially frequent and severe injuries in crashes. Statistics also indicate that small cars crash more often than large cars. Now, new evidence shows that people *die* in crashes in small cars more often than in larger vehicles. Even among small cars, some models have much worse injury and fatality experience than others. For example, people in most Japanese-built small cars are considerably more vulnerable to injury and death than people in counterpart American-made vehicles.

Insurance claims for the past three years show significant differences in the first party injury claims experience of various automobiles. See Exhibit I.

This list ranges from the Oldsmobile Custom Cruiser station wagon with the best experience to a Japanese-made subcompact, the Dodge Challenger, with the worst experience. The Challenger has an injury claim frequency rate 62 percent higher than the average for all cars.

Of the 17 cars (1978-1980 models) with the worst insurance injury claim experience, all are subcompacts or smaller. Conversely, of the 19 cars with the best records, only 7 are compacts or small compacts. All of those with the best experience are domestics.

EXHIBIT I

1978—80 MODELS WITH THE BEST INSURANCE INJURY CLAIM EXPERIENCE

(A relative injury claim frequency of 100 is average)

Make	Body	Size	Relative Frequency
Olds. Custom Cruiser	S.W.	I	58
Oldsmobile Toronado	Spec.	I	58
Buick Estate	S.W.	I	62
Oldsmobile 98	4 Dr.	I	62
Oldsmobile Cutlass	S.W.	C	65
Oldsmobile Omega	4 Dr.	SC	66
Chevrolet Caprice	S.W.	I	67
Pontiac Bonneville	S.W.	I	67
Oldsmobile Delta 88	4 Dr.	I	69
Pontiac Catalina	4 Dr.	I	69
Buick LeSabre	4 Dr.	I	73
Mercury Marquis	4 Dr.	I	74
Buick Century	S.W.	C	76
Chevrolet Malibu	S.W.	C	78
Mercury Zephyr	S.W.	SC	80
Buick Century	4 Dr.	C	83
Chevrolet Citation	4 Dr.	SC	83
Dodge Aspen	4 Dr.	I	84
Plymouth Volare	S.W.	I	87

1978—80 MODELS WITH THE WORST INSURANCE INJURY CLAIM EXPERIENCE

(A relative injury claim frequency of 100 is average)

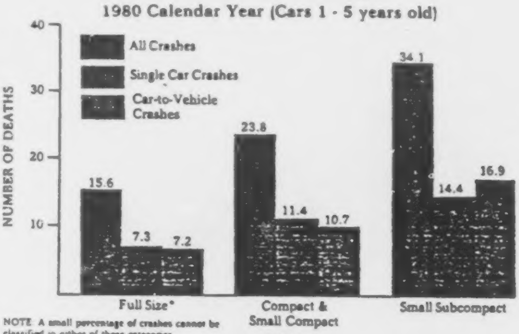
Make	Body	Size	Relative Frequency
Dodge Challenger†	2 Dr.	S	162
Fiat Brava	**	S	156
Toyota Corolla Tercel	2 Dr.	S	153
Datsun 200SX	2 Dr.	SS	150
Plymouth Sapporo†	2 Dr.	S	149
Plymouth Arrow†	2 Dr.	SS	148
Dodge Omni	2 Dr.	S	142
Honda Prelude	2 Dr.	SS	140
Mazda GLC	**	SS	139
Honda Civic	2 Dr.	SS	135
Datsun 210	**	SS	135
Plymouth Champ†	2 Dr.	SS	134
Mazda RX-7	Sport	SS	132
Mercury Bobcat	2 Dr.	SS	131
Toyota Corolla	**	SS	130
Ford Mustang	2 Dr.	S	128
Honda Civic	S.W.	SS	119

Source: Highway Loss Data Institute. † = Japanese-made.
Car Sizes: I = Intermediate, C = Compact, SC = Small Compact, S = Subcompact, SS = Small Subcompact. See DEFINITIONS on page 6.
Body Styles: SW = Station Wagon, Spec. = Specialty, ** = Not determined.

Dr. Haddon is the president of the Insurance Institute for Highway Safety and of the Highway Loss Data Institute

EXHIBIT III
DEATHS PER 100,000 REGISTERED CARS
by Car Size and Crash Type
1980 Calendar Year (Cars 1 - 5 years old)

IIHS 1981



NOTE: A small percentage of crashes cannot be classified in either of these categories.
*See definitions on page 6 for wheelbase sizes.

Small is a reality

The trend to small cars is undeniable. Increasing numbers of Americans are driving small cars and it is not realistic to expect people to travel only in large cars. Because small cars are a reality, it is important to know that some are significantly safer than others. Therefore, this report presents comparisons of the crashworthiness of the most common models of small cars.

Recent IIHS and HLDI studies show that, on the whole, small American-built automobiles are safer than their Japanese-made counterparts. (Japanese cars were chosen for close study because they are so numerous, and because insurance data show many of them to have high crash frequencies and crash injury rates.) To appreciate the significance of the study results however, one must first understand the extent of involvement of small cars in crashes.

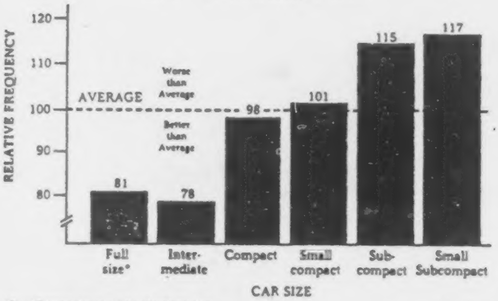
Small car hazards

A common perception among small car drivers is that they are in a better position to avoid crashes than are drivers of large cars. However, studies show that as cars become smaller, they are more frequently involved in crashes and their occupants tend to be injured more often and more severely (Exhibit II). Unfortunately, the hazards of small cars are not confined to crashes with larger vehicles.

SMALL CARS ARE TWICE AS LIKELY AS LARGE CARS TO BE INVOLVED IN FATAL SINGLE VEHICLE CRASHES.

IIHS comparisons of car sizes show that occupants of small cars are more than twice as likely as people in large cars to be killed in crashes of all kinds. They are also twice as likely to be killed in single vehicle crashes. Small cars are four times as likely to be involved in fatal single vehicle rollover crashes. In car-to-car crashes, the risk of death is three times as

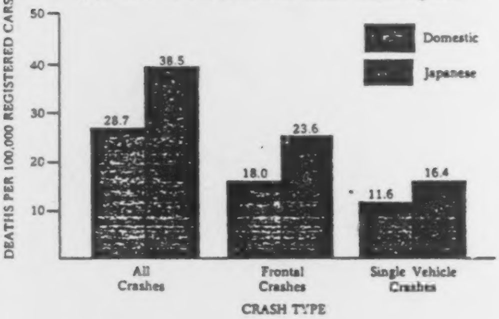
EXHIBIT II
RELATIVE INJURY CLAIM FREQUENCIES
BY CAR SIZE
1978 - 1980 Passenger Cars



*See definitions on page 6 for wheelbase sizes.

HLDI - 1981

EXHIBIT IV
COMPARISON OF 1980 DEATH RATES BY CRASH TYPE
Japanese Versus Domestic Small Subcompacts



great in a small car as in a large car (Exhibit III).

Even when small cars crash with small cars, occupants are killed and injured more frequently than in crashes between two larger cars.

Given these findings, the need to compare the crash injury experience of various small car models becomes especially urgent.

Comparing small cars

A car's effectiveness in protecting its occupants in a crash is the measure of its "crashworthiness." There are three main aspects of crashworthiness: the extent to which occupants are kept in the car (i.e., not ejected) in a crash; the extent to which a car's structure holds up instead of collapsing on occupants in a crash; and the extent to which the forces of a crash are absorbed by the car instead of by the driver and passengers.

In all three areas, small cars fare worse than larger vehicles. The percentage of fatal crashes involving occupant ejection, for example, is about twice as high for small subcompacts as for full-size cars.

IIHS studies further indicate that most American-made cars, including small cars, provide better crash protection than imports.

INJURIES: American-built cars have consistently shown better injury claims records than most imports. Thirteen of the 17 cars with the worst insurance injury claims experience are made in Japan (Exhibit I). In the compact size group, the Toyota Celica Supra has the worst experience, whereas American-made cars have the best experience overall. In the subcompact category, those cars with the worst experience are also mostly imports (Dodge

IN GENERAL, AMERICAN-BUILT CARS HAVE BETTER INSURANCE INJURY CLAIM RECORDS THAN IMPORTS.

ABOUT IIHS AND HLDI

This report presents the highlights of new findings by the Insurance Institute for Highway Safety (IIHS) and the Highway Loss Data Institute (HLDI). These are independent, non-profit, research and educational organizations that identify, evaluate and develop ways to reduce human and economic losses resulting from motor vehicle crashes. Both IIHS and HLDI are supported by various insurance industry safety organizations, and major insurance companies, including USAA.

IIHS and HLDI publish hundreds of documents covering the subject of highway losses and loss reduction. Copies of these studies, as well as copies of the IIHS Selected Bibliography, are available on request, at no charge. ***For further information, contact the Communications Department, Insurance Institute for Highway Safety, Watergate 600, Washington, DC 20037.***

> *"...Inasmuch as the IIHS is funded by the insurance industry, there is a natural suspicion that the institute might have a pro-industry bias. I have looked for bias in IIHS activities and publications but have found only a bias toward reducing the number of people who smash up their automobiles and their bodies.*
>
> *This is a bias I share. I have been reading IIHS reports for decades and find them informative, reliable and useful..."*
>
> *Bill Gold, WASHINGTON POST, April 1, 1981.*

Challenger, Fiat Brava, Toyota Corolla Tercel, and Datsun 200SX). The American Pacer station wagon has the best experience in this size group (Exhibit V).

13 OF THE 17 CARS WITH THE WORST INJURY LOSS EXPERIENCE ARE MADE IN JAPAN.

DEATHS: The most recent evidence indicates that the risk of being killed in a crash is particularly high in most small subcompacts imported from Japan. On the average, the death rate in these cars is 34 percent higher than in the same size class American-made cars. To be more specific, the death rate in frontal crashes (the kind that

DEFINITIONS

Claim Frequency — The number of claims for a group of vehicles divided by the exposure for that group; exposures are expressed in units of insured vehicle years. A relative injury claim frequency of 100 is average.

Vehicle Size Class — A grouping of vehicles based on wheelbase size: *Small Subcompact* — Cars with wheelbases less than or equal to 96 inches; *Subcompact* — Cars with wheelbases greater than 96 inches and less than or equal to 101 inches; *Small Compact* — Cars with wheelbases greater than 101 inches and less than or equal to 106 inches; *Compact* — Cars with wheelbases greater than 106 inches and less than or equal to 111 inches; *Intermediate* — Cars with wheelbases greater than 111 inches and less than or equal to 120 inches; *Full Size* — Cars with wheelbases greater than 120 inches.

EXHIBIT V

RELATIVE INJURY CLAIM FREQUENCY SMALL CARS, 1978 - 80 MODELS

(A relative frequency of 100 is the average for all cars)

COMPACT & SMALL COMPACT

Make	Body	Relative Frequency
Oldsmobile Cutlass	S.W.	65
Oldsmobile Omega	4 Dr.	66
Lincoln Versailles	Spec.	74
Buick Century	S.W.	76
Chevrolet Malibu	S.W.	78
Pontiac Lemans	4 Dr.	79
Oldsmobile Cutlass	4 Dr.	80
Buick Skylark	2 Dr.	80
Mercury Zephyr	S.W.	80
Audi 5000 (G)	4 Dr.	80
Buick Century	4 Dr.	83
Chevrolet Citation	4 Dr.	83
Pontiac Lemans	S.W.	84
Chevrolet Malibu	4 Dr.	88
Ford Granada	4 Dr.	88
Buick Skylark	4 Dr.	89
Ford Fairmont	S.W.	90
Pontiac Lemans	2 Dr.	92
Mercury Monarch	2 Dr.	92
Oldsmobile Cutlass	2 Dr.	92
Buick Century	2 Dr.	93
Mercury Monarch	4 Dr.	96
American Concord	S.W.	97
Chevrolet Malibu	2 Dr.	97
Pontiac Phoenix	4 Dr.	98
Chevrolet Citation	2 Dr.	98
Pontiac Grand Prix	Spec.	98
Buick Regal	2 Dr.	100
Ford Fairmont	4 Dr.	101
Mercury Zephyr	4 Dr.	102
American Concord	2,4 Dr.	102
Ford Granada	2 Dr.	102
Plymouth Volare	2 Dr.	107
Toyota Cressida (J)	4 Dr.	108
Chevrolet Monte Carlo	Spec.	109
Ford Fairmont	2 Dr.	111
Dodge Aspen	2 Dr.	112
Pontiac Firebird	Spec.	113
Chevrolet Camaro	Spec.	113
Mercury Zephyr	2 Dr.	120
Ford Thunderbird	Spec.	121
Toyota Celica Supra (J)	2 Dr.	128

SUBCOMPACT & SMALL SUBCOMPACT

Make	Body	Relative Frequency
American Pacer	S.W.	81
VW Dasher (G)	S.W.	87
VW Rabbit (A/G)	2 Dr.	90
VW Dasher (G)	2 Dr.	91
Honda Accord (J)	4 Dr.	93
Mercury Bobcat	S.W.	97
Datsun 210 (J)	S.W.	103
Honda Accord (J)	2 Dr.	103
Datsun 510 (J)	S.W.	104
Ford Pinto	S.W.	104
Dodge Omni	4 Dr.	104
Toyota Corona (J)	4 Dr.	106
Plymouth Horizon	4 Dr.	106
Volkswagen Scirocco (G)	2 Dr.	110
American Spirit	2 Dr.	110
Chevrolet Chevette	4 Dr.	110
Datsun 510 (J)	2 Dr.	112
Pontiac Sunbird	2 Dr.	112
Mazda GLC (J)	S.W.	113
Mazda 626 (J)	2 Dr.	115
Chevrolet Chevette	2 Dr.	119
Honda Civic (J)	S.W.	119
Ford Pinto	2 Dr.	120
Plymouth Horizon	2 Dr.	120
Toyota Celica (J)	2 Dr.	120
Buick Skyhawk	2 Dr.	120
Chevrolet Monza	2 Dr.	121
Mercury Capri	2 Dr.	122
Ford Fiesta (G)	2 Dr.	126
Dodge Colt, 4WD (J)	2 Dr.	128
Datsun 310 (J)	2 Dr.	128
Ford Mustang	2 Dr.	128
Oldsmobile Starfire	2 Dr.	128
Toyota Corolla (J)	2 Dr.	130
Mercury Bobcat	2 Dr.	131
Plymouth Champ (J)	2 Dr.	134
Datsun 210 (J)	2 Dr.	135
Honda Civic (J)	2 Dr.	135
Mazda GLC (J)	2 Dr.	139
Honda Prelude (J)	2 Dr.	140
Dodge Omni	2 Dr.	142
Plymouth Arrow (J)	2 Dr.	148
Plymouth Sapporo (J)	2 Dr.	149
Datsun 200SX (J)	2 Dr.	150
Toyota Corolla Tercel (J)	2 Dr.	153
Fiat Brava (I)	2 Dr.	156
Dodge Challenger (J)	2 Dr.	162

All cars are American-made unless otherwise indicated. J = Japanese, G = German, I = Italian. Sports cars are excluded. See DEFINITIONS at left for wheelbase sizes.

Source: Highway Loss Data Institute (Results not reported for cars on which insufficient data are available.)

accounts for most highway fatalities) is 31 percent higher in Japanese small subcompacts than in their American counterparts. In single vehicle crashes, these Japanese cars have a 41 percent higher death rate than domestics in the same size group (Exhibit IV, page 5).

The extent to which Japanese and American cars sustain collision damage generally mirrors these injury and death trends.

Conclusion

The trouble with many of today's small cars is that they are essentially scaled down versions of large cars. They are not designed and engineered with the special problems of smaller size, lighter weight and lower profile in mind. Conserving lives and reducing injuries while maintaining energy-efficiency means making cars as lightweight as practical while providing enough crash-absorbing outer structures and occupant compartment protection to assure maximum injury reduction in crashes. These improvements are feasible now, using present technology, and would mean the difference between life and death for many small car occupants.

THE TECHNOLOGY EXISTS TO MAKE VEHICLES MORE CRASHWORTHY.

METHODOLOGY

This report is based on real world data. The data include the actual claims experience of 10 major insurance companies that insure about half of the private passenger vehicles in the United States. These companies supply data to the Highway Loss Data Institute (HLDI) which uses them to compare the loss experience of various vehicles. HLDI's latest passenger car injury report includes over five million insured vehicle years and nearly 100,000 Personal Injury Protection claims. To minimize bias, HLDI results are adjusted to eliminate possible distortions due to the fact that youthful drivers use some car models more often than others. (The crash experience of youthful drivers is worse than that of other drivers, on the average.)

The death rates included in this report are based on Insurance Institute for Highway Safety (IIHS) analyses of national data from the federal government's Fatal Accident Reporting System (FARS), as well as national data on the total numbers of different kinds of vehicles registered in the United States. All passenger car occupant fatalities during 1978-1980 occurring in cars 1 to 5 years old were examined by car size and country of manufacture of the vehicle.

WHAT CAN BE DONE?

Unless improvements are made, more small cars on the road in the future will mean more people dying in crashes. And, as even smaller cars enter the roadways during the next decade, they may bring with them even higher death tolls.

It need not be this way. Manufacturers can build small cars that would better protect people in crashes. In fact, the time for such changes has never been more favorable. The American automobile is undergoing a sweeping overhaul of its design and manufacture; it is shrinking, losing weight, and becoming more fuel-efficient. At the same time cars could also be outfitted with greater crash protection, especially since the technology for such improvements already exists.

Manual Belts: If you drive a small car and do not wear your seat belt, you are increasing your risk of death by a factor of about four, compared to a belted person in a large car. By wearing your seat belt, your risk is reduced to about the level of an unbelted occupant of a large car.

Automatic Belts: One way to protect people who do not use manual belts is to install seat belts that automatically position themselves around front-seat occupants when they enter the car. Automatic seat belts are currently available in only a few cars on the road, including some Volkswagen Rabbits. The seat belt usage rate is almost 80 percent in Rabbits with automatic belts, compared to about 35 percent in Rabbits with manual belts. This difference has resulted in a substantially lower occupant death rate for the models with automatic belts.

Air Bags: In contrast to manual and even automatic belts, air bags would have a use level of virtually 100 percent from the time they are installed, since they would be deployed automatically to cushion occupants in a frontal crash. In more than 800 million miles of actual use and hundreds of tests, air bags have proven to be highly effective in reducing the crash forces that cause injuries and deaths. Yet today, only a very few cars — none of them small cars — are equipped with air bags. No new cars with air bags can now be purchased in the United States.

Non-Lacerating Windshields: Since 1969, the windshields required on all cars have had a plastic sheet laminated beween layers of glass to reduce head penetration and facial lacerations in crashes.

continued on reverse

USAA GROUP
San Antonio, TX 78288

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But the layer of glass nearest the occupants still causes severe injuries — Americans suffer about 266,000 facial lacerations and 52,000 facial fractures annually in motor vehicle crashes. Disproportionate numbers of these injuries occur in small cars.

An alternative windshield design, developed in Europe and already on thousands of cars there, provides an extra layer of plastic on the surface of the windshield nearest the occupants, effectively reducing the laceration problem. The Department of Transportation is considering changing the applicable federal standard to permit these new windshields in the United States.

Child Restraints: More than 90 percent of children ride in motor vehicles without the protection of available seat belts or child restraints. Every year, 1400 children die in crashes and the highest death rate is in the first year of life. When child restraint systems are used, they provide excellent protection in serious crashes and also in non-crash incidents such as sudden stops, swerves and turns.

Crashworthiness: Consumers have endorsed the idea of the federal government rating new cars for crashworthiness – and have indicated their willingness to pay for such ratings. While the make of a car, its price and fuel efficiency are prime decision-making factors in buying a car, crashworthiness ratings would enable consumers to make an informed choice on the basis of the relative safety a vehicle affords. In addition, ratings would encourage auto manufacturers to acknowledge safety concerns and market more crashworthy products.

Consumer concern and commitment will have the greatest impact on how soon and to what extent automobiles become safer. Ultimately, individuals can have tremendous impact with the decisions they make in new car showrooms.

The RSV: The U.S. government has sponsored the building of several small cars, called Research Safety Vehicles (RSVs), which are lightweight and energy-efficient, and which embody most of the latest safety engineering and design concepts. Energy-absorbing steel body structures maintain the RSV's structural integrity in a crash. Soft interior padding cushions occupant impact. In addition, the RSV has air bags. The car pictured, made by Calspan, has a non-lacerating windshield. In all RSVs, hostile protrusions have been removed, relocated, or recessed in the instrument panel. The improvements are feasible and practical to implement right now.

PRESIDENT'S POSTSCRIPT

We hope you'll think about this information and share it with your non-USAA friends and associates. Your concerned action will help to bring about a greater regard for crashworthiness on everyone's part.

If you would like more copies of this publication, write to USAA c/o *Aide* for free reprints.

Attachment II

S-I 80-1

SUMMARY OF

INJURY CLAIMS EXPERIENCE

FOR PASSENGER CARS

HIGHWAY LOSS DATA INSTITUTE WATERGATE 600 WASHINGTON, D.C. 20037

The Highway Loss Data Institute (HLDI) is a non-profit, public service organization that gathers, processes, and publishes insurance data concerning human and economic losses resulting from owning and operating motor vehicles, and in particular the way such losses vary among different kinds of vehicles.

The table in this publication is a summary of information from HLDI's recent injury loss report for passenger cars. In the table, the number of injury claims associated with each vehicle is stated in relative terms, with 100 representing the average injury claim frequency for all insured passenger cars. Thus, an injury claim frequency of 122 is 22 percent higher than average; a frequency of 96 is 4 percent lower than average.

In addition to presenting overall relative claim frequencies for each car type, injury claim frequencies are also presented by size of claim (> $250, > $500, > $1,000) to allow comparisons among car types with respect to the occurrence of injuries of different severities. Results are not reported in claim size categories for which insufficient data are available.

SUMMARY

- There are 19 individual vehicle series with at least one claim frequency result that was 30 percent or more below (better than) the result for all cars combined. Among these cars, 12 were intermediate size and most were station wagons or regular four-door models. No regular two-door models were among the cars with the best experience. All 19 of the best cars were manufactured in the United States, 15 of them by General Motors.

- There are 17 individual vehicle series with at least one claim frequency result that was 30 percent or more above (worse than) the all-car result. All of these 17 cars were either small subcompact or subcompact size and most were regular two-door models. Fourteen of the seventeen were imported models.

- Many of the vehicles with the worst injury loss experience had claim frequencies which were more than double those of many of the vehicles with the best injury loss experience.

- Among the cars with the best injury loss experience, the Oldsmobile Toronado and the Oldsmobile Custom Cruiser had the lowest overall claim frequency (42 percent below average). The Buick Estate station wagon had the lowest frequency of claims exceeding $250 (48 percent below average), and the Oldsmobile Custom Cruiser and the Buick Century station wagon had the lowest frequency of claims greater than $500 (43 percent below average). The Chevrolet Caprice station wagon had the lowest frequency of claims greater than $1,000 (43 percent below average).

- Among the cars with the worst injury loss experience, the Dodge Challenger had the highest overall claim frequency (62 percent above average). The Plymouth Arrow (manufactured in Japan by Mitsubishi) had the highest frequency of claims exceeding $250 (65 percent above average).

- There was a general pattern of declining claim frequencies with increasing car size through the intermediate size class for all claim size categories. However, there were large variations in injury claim frequencies among cars in the same car size and body style groups.

- Two-door models consistently had higher injury claim frequencies than four-door models of the same size.

- The *relative* claim frequencies for sports and specialty models consistently increased as the claim size amounts increased.

A single copy of the full report (I 80-1) from which this table is excerpted is available on request, at no charge, by writing to: Highway Loss Data Institute, Watergate 600, Washington, D.C. 20037.

DEFINITIONS

Claim Frequency – The number of claims for a group of vehicles, divided by the exposure for that group; expressed as claims per one thousand insured vehicle years.

Exposure – The time interval an individual vehicle is insured. Exposure for a group of vehicles is expressed in units of insured vehicle years. Minimum exposure requirements for reporting results in the table are:

All claims –	5,000 Vehicle Years
Claims greater than (>) $250 –	10,000 Vehicle Years
Claims greater than (>) $500 –	15,000 Vehicle Years
Claims greater than (>) $1,000 –	25,000 Vehicle Years

Personal Injury Protection (PIP) Coverage – First-party no-fault coverage in which an insurer pays, within the specified limits, the medical, hospital, and other expenses of the insured, others in his vehicle, and pedestrians struck by him.

Vehicle Series – A name denoting a family of vehicles, within a make, with the same wheelbase and a degree of commonality in construction such as body, chassis, etc.

Vehicle Size Group – A grouping of vehicles based on wheelbase. There are six car size groups defined as follows:

Small Subcompact – Cars with wheelbases less than or equal to 96 inches.
Subcompact – Cars with wheelbases greater than 96 inches and less than or equal to 101 inches.
Small Compact – Cars with wheelbases greater than 101 inches and less than or equal to 106 inches.
Compact – Cars with wheelbases greater than 106 inches and less than or equal to 111 inches.
Intermediate – Cars with wheelbases greater than 111 inches and less than or equal to 120 inches.
Full-Size – Cars with wheelbases greater than 120 inches.

Each vehicle size group is further divided into four subgroups – regular two-door models, regular four-door models, station wagons, and sports or specialty models. In the small compact, compact, intermediate, and full-size groups, the specialty models are those that either have *only* two-door models or are luxury cars. The sports subgroups in the two subcompact size classes are sports models which are basically two-seater cars.

Youthful Operator – For the purposes of this report, all males (married or single) under 25 years of age and all unmarried females under 25 years of age. Results in the table are standardized to the distribution: Youthful Operator, 15%; No Youthful Operator, 85%.

RELATIVE CLAIM FREQUENCY BY SIZE OF CLAIM PERSONAL INJURY PROTECTION COVERAGES 1978-1980 PASSENGER CARS

MODEL				SIZE OF CLAIM			
YEARS	MAKE AND SERIES		EXPOSURE	ALL	>$250	>$500	>$1,000
78-80	**ALL CARS**		**5,454,801**	**100**	**100**	**100**	**100**
	Claims Per 1,000 Insured Vehicle Years			**=17.8**	**=6.9**	**=4.6**	**=2.8**
78-80	**ALL SMALL SUBCOMPACT**		**1,015,104**	**117**	**114**	**111**	**111**
78-80	**Regular Two-Door Models**		**848,025**	**119**	**116**	**111**	**111**
78-80	Volkswagen	Rabbit*	164,051	90	87	85	86
78-80	Honda	Accord	70,105	103	101	107	107
78-80	Volkswagen	Scirocco	20,239	110	106	109	
79-80	American	Spirit	19,763	110	100	102	
78-80	Datsun	510*	22,804	112	109	102	
78-80	Chevrolet	Chevette	107,266	119	116	109	107
78-80	Ford	Pinto	91,174	120	113	107	104
78-80	Ford	Fiesta	37,387	126	125	115	118
79-80	Dodge	Colt (FWD)	12,208	128	116		
79-80	Datsun	310*	22,362	128	113	102	
80	Toyota	Corolla*	19,445	130	129	126	
78-80	Mercury	Bobcat	19,136	131	125	107	
79-80	Plymouth	Champ	10,793	134	132		
78-80	Datsun	210*	82,618	135	133	126	118
78-80	Honda	Civic	80,170	135	139	137	136
78-80	Mazda	GLC*	33,258	139	142	133	139
79-80	Honda	Prelude	11,926	140	146		
78-80	Plymouth	Arrow	14,403	148	165		
80	Datsun	200SX	7,159	150			
78-80	**Regular Four-Door Models**		**13,681**	**93**	**94**	**78**	
79-80	Honda	Accord	18,681	93	94	78	
78-80	**Station Wagons**		**96,895**	**107**	**101**	**102**	**104**
78-80	Mercury	Bobcat	5,640	97			
79-80	Datsun	210	19,005	103	97	96	
78-80	Datsun	510	16,880	104	96	104	
78-80	Ford	Pinto	33,054	104	93	85	82
79-80	Mazda	GLC	6,048	113			
78-80	Honda	Civic	16,269	119	130	146	
78-80	**Sports**		**51,502**	**120**	**130**	**133**	**136**
78-80	Fiat	Spider 2000	5,136	105			
79-80	Datsun	280ZX	11,577	112	126		
78-80	MG	MGB	7,098	116			
79-80	Mazda	RX7	18,088	132	142	146	
78-80	**ALL SUBCOMPACT**		**865,479**	**115**	**114**	**113**	**114**
78-80	**Regular Two-Door Models**		**533,795**	**122**	**123**	**120**	**118**
78-80	Volkswagen	Dasher*	13,116	91	96		
78-80	Pontiac	Sunbird	72,686	112	114	109	111
79-80	Mazda	626*	8,354	115			
79-80	Plymouth	Horizon	22,782	120	117	111	
78-80	Toyota	Celica	93,616	120	123	126	121
78-80	Buick	Skyhawk	13,780	120	122		
78-80	Chevrolet	Monza	99,151	121	120	115	107
79-80	Mercury	Capri	30,172	122	120	122	121
79-80	Ford	Mustang	109,383	128	130	133	121

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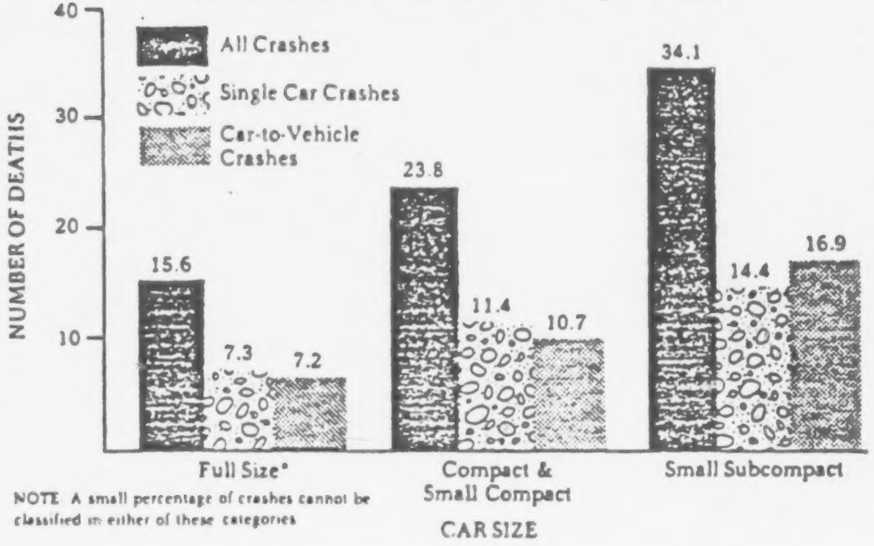
*This entry includes both two- and four-door models.

MODEL				SIZE OF CLAIM			
YEARS	MAKE AND SERIES		EXPOSURE	ALL	> $250	> $500	> $1,000
78-80	**SUBCOMPACT, continued**						
78-80	**Regular Two-Door Models, continued**						
78-80	Oldsmobile	Starfire	13,539	128	123		
79-80	Dodge	Omni	18,214	142	139	143	
78-80	Plymouth	Sapporo	6,941	149			
80	Toyota	Corolla Tercel	9,378	153			
78-80	Fiat	Brava*	6,572	156			
78-80	Dodge	Challenger	7,717	162			
78-80	**Regular Four-Door Models**		**281,224**	**108**	**104**	**104**	**107**
78-80	Dodge	Omni	54,094	104	104	107	114
79-80	Toyota	Corona*	10,513	106	97		
78-80	Plymouth	Horizon	75,337	106	112	115	114
78-80	Chevrolet	Chevette	141,280	110	103	98	100
78-80	**Station Wagons**		**16,974**	**85**	**90**	**87**	
78-80	American	Pacer	6,429	81			
78-80	Volkswagen	Dasher	7,209	87			
78-80	**Sports**		**33,486**	**87**	**100**	**109**	**121**
78-80	Chevrolet	Corvette	28,788	81	97	107	125
78-80	**ALL SMALL COMPACT**		**437,341**	**101**	**97**	**96**	**93**
78-80	**Regular Two-Door Models**		**184,365**	**110**	**109**	**107**	**104**
80	Buick	Skylark	7,291	80			
80	Chevrolet	Citation	17,627	98	93	83	
78-80	Ford	Fairmont	110,624	111	110	113	111
78-80	Mercury	Zephyr	35,194	120	122	113	107
79-80	Toyota	Celica Supra	5,607	128			
78-80	**Regular Four-Door Models**		**160,500**	**96**	**91**	**91**	**96**
80	Oldsmobile	Omega	5,164	66			
78-80	Audi	5000	13,606	80	74		
80	Chevrolet	Citation	23,166	83	77	63	
80	Buick	Skylark	10,989	89	72		
80	Pontiac	Phoenix	6,429	98			
78-80	Ford	Fairmont	69,666	101	100	100	104
78-80	Mercury	Zephyr	22,442	102	93	100	
78-80	Toyota	Cressida	5,350	108			
78-80	**Station Wagons**		**92,477**	**89**	**80**	**80**	**75**
78-80	Mercury	Zephyr	15,996	80	74	61	
78-80	Ford	Fairmont	71,377	90	83	83	75
78-80	**ALL COMPACT**		**1,810,493**	**98**	**99**	**98**	**100**
78-80	**Regular Two-Door Models**		**753,898**	**97**	**99**	**98**	**96**
78-80	Pontiac	Lemans	21,138	92	84	80	
78-80	Mercury	Monarch	17,682	92	100	89	
78-80	Oldsmobile	Cutlass	293,757	92	94	93	89
78-80	Buick	Century	8,220	93			
78-80	Chevrolet	Malibu	81,209	97	91	89	89
78-80	Buick	Regal	173,645	100	106	107	111
78-80	American	Concord	33,516	102	100	98	104
78-80	Ford	Granada	55,225	102	103	102	93
78-80	Plymouth	Volare	36,161	107	101	96	93
78-80	Dodge	Aspen	26,237	112	101	104	96

MODEL YEARS	MAKE AND SERIES		EXPOSURE	SIZE OF CLAIM			
				ALL	>$250	>$500	>$1,000
78-80	**COMPACT, continued**						
78-80	**Regular Four-Door Models**		**273,120**	**87**	**87**	**83**	**82**
78-80	Pontiac	Lemans	26,948	79	83	85	86
78-80	Oldsmobile	Cutlass	35,941	80	86	89	89
78-80	Buick	Century	21,331	83	74	65	
78-80	Chevrolet	Malibu	84,144	88	83	80	86
78-80	Ford	Granada	60,899	88	88	80	82
78-80	Mercury	Monarch	23,254	96	104	100	
78-80	American	Concord	19,811	102	103	91	
78-80	**Station Wagons**		**159,577**	**78**	**70**	**72**	**71**
78-80	Oldsmobile	Cutlass	31,627	65	64	67	68
78-80	Buick	Century	22,062	76	59	57	
78-80	Chevrolet	Malibu	65,679	78	70	67	64
78-80	Pontiac	Lemans	23,031	84	74	85	
78-80	American	Concord	14,811	97	100		
78-80	**Specialty**		**623,898**	**107**	**112**	**115**	**114**
78-80	Lincoln	Versailles	6,376	74			
78-80	Pontiac	Grand Prix	147,257	98	101	104	104
78-80	Chevrolet	Monte Carlo	200,561	109	116	120	121
78-80	Pontiac	Firebird	104,533	113	116	120	125
78-80	Chevrolet	Camaro	149,811	113	114	115	114
80	Ford	Thunderbird	11,309	121	120		
78-80	**ALL INTERMEDIATE**		**1,184,583**	**78**	**80**	**80**	**82**
78-80	**Regular Two-Door Models**		**233,359**	**83**	**90**	**93**	**93**
78-80	Buick	LeSabre	34,687	75	75	74	71
78-80	Oldsmobile	Ninety Eight	17,288	77	106	122	
78-80	Pontiac	Bonneville	28,643	80	80	85	79
78-80	Chevrolet	Caprice	32,939	83	77	85	89
79-80	Mercury	Marquis	5,814	84			
78-80	Oldsmobile	Delta 88	49,024	84	93	98	96
78-80	Chevrolet	Impala	19,086	85	87	96	
79-80	Ford	LTD	19,964	88	101	102	
78-80	Buick	Electra	21,004	100	123	122	
78-80	**Regular Four-Door Models**		**663,597**	**77**	**78**	**76**	**79**
78-80	Oldsmobile	Ninety Eight	44,223	62	70	74	75
78-80	Oldsmobile	Delta 88	87,667	69	70	72	68
78-80	Pontiac	Catalina	16,901	69	75	78	
78-80	Buick	LeSabre	59,241	73	71	70	64
78-80	Pontiac	Bonneville	52,551	73	77	74	71
79-80	Mercury	Marquis	15,165	74	72	65	
78-80	Chevrolet	Caprice	105,742	76	78	78	82
78-80	Buick	Electra	36,015	78	80	80	82
79-80	Ford	LTD	30,075	78	78	80	79
79-80	Chrysler	Newport	9,942	80			
78-80	Dodge	Diplomat	12,306	81	74		
78-80	Chevrolet	Impala	74,873	84	86	87	96
78-80	Dodge	Aspen	33,056	84	75	70	64
79-80	Dodge	St. Regis	5,423	87			
78-80	Chrysler	Le Baron	30,993	88	83	74	93

MODEL	MAKE AND SERIES			SIZE OF CLAIM			
YEARS			EXPOSURE	ALL	> $250	> $500	> $1,000
78-80	**INTERMEDIATE, continued**						
78-80	**Regular Four-Door Models, continued**						
79-80	Chrysler	New Yorker	8,311	89			
78-80	Plymouth	Volare	40,942	93	88	89	89
78-80	**Station Wagons**		**213,429**	**75**	**70**	**67**	**68**
78-80	Oldsmobile	Custom Cruiser	18,210	58	58	57	
78-80	Buick	Estate	11,760	62	52		
78-80	Pontiac	Bonneville	8,967	67			
78-80	Chevrolet	Caprice	32,359	67	61	63	57
78-80	Chrysler	Le Baron	11,858	71	72		
78-80	Dodge	Diplomat	5,503	74			
78-80	Pontiac	Catalina	7,220	75			
78-80	Chevrolet	Impala	31,960	76	75	80	82
79-80	Ford	LTD	12,316	79	80		
78-80	Plymouth	Volare	39,562	87	72	67	71
78-80	Dodge	Aspen	30,422	89	87	80	82
78-80	**Specialty**		**74,198**	**77**	**88**	**89**	**93**
79-80	Oldsmobile	Toronado	12,206	58	61		
79-80	Buick	Riviera	14,853	75	90		
78-80	Cadillac	Seville	21,169	79	90	91	
79-80	Cadillac	Eldorado	16,537	80	90	100	
78-80	**ALL FULL-SIZE**		**141,801**	**81**	**100**	**107**	**114**
78-80	**Specialty**		**141,801**	**81**	**100**	**107**	**114**
78-80	Cadillac	De Ville 4D	50,371	74	90	93	104
78-80	Cadillac	Brougham 4D	16,700	82	88	100	
78-80	Cadillac	De Ville 2D	74,531	86	110	120	121

DEATHS PER 100,000 REGISTERED CARS
by Car Size and Crash Type
1980 Calendar Year (Cars 1 - 5 years old)

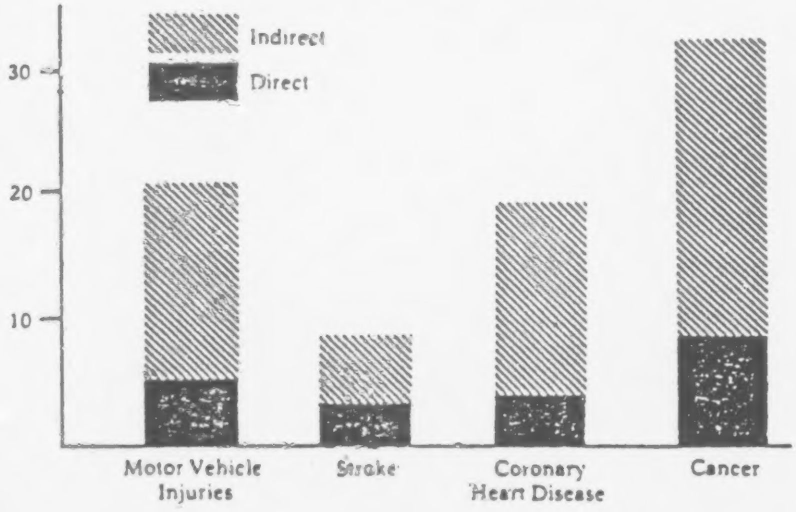


NOTE: A small percentage of crashes cannot be classified in either of these categories.

Source: Insurance Institute for Highway Safety 1981

ESTIMATED DIRECT AND INDIRECT COSTS ASSOCIATED WITH INCIDENCE OF CANCER, CORONARY HEART DISEASE, MOTOR VEHICLE INJURIES, AND STROKE IN 1975

(In Billions of 1980 Dollars)



Source: Insurance Institute for Highway Safety 1981

Attachment III

INSURANCE INSTITUTE FOR HIGHWAY SAFETY
WATERGATE SIX HUNDRED, WASHINGTON, D.C. 20037 · 202/333-0770

January 5, 1982

Memo to Editors and Correspondents:

This special issue of Status Report pulls together and analyzes some significant new findings about motor vehicle fatalities in various sizes and kinds of cars. And it releases for the first time information -- based on data from actual fatal crashes -- about the relative hazards associated with large and small cars, domestic and Japanese models.

Highlights of the research include the following: deaths in small cars were found to be alarmingly high in all kinds of crashes (not just crashes with larger vehicles); some kinds of small cars were found to have far more deaths per registered vehicle than others, and the chance of being killed in a Japanese-made small car was found to be about 40 to 60 percent higher (depending on the type of crash) than in a comparable domestic car.

The reports and graphs throughout this issue provide more details. Should you desire additional information, please give us a call.

Paul C Hood

Paul C. Hood
Editor, Status Report

insurance institute for highway safety

the highway loss reduction
Status Report

Vol. 17, No. 1
January 5, 1982

A Special Issue

Car Size, Deaths Linked; Small Imports Found Worst

Deaths per registered vehicle in the smallest cars on the road – subcompacts and small subcompacts – are *twice as high* as in the largest cars. No matter what kind of crash, whether frontal, single-vehicle, rollover, ejection, car-to-car, or car-to-other-vehicle, the number of deaths per registered small car is alarmingly high.

Small cars as a group have extremely high death and injury rates. Within the group, some small cars are markedly *less* crashworthy than others. In particular, the group of Japanese-made small subcompacts accounts for more deaths per registered vehicle than domestic models in their size group.

Researchers have known for years that people in smaller, lighter cars are injured more often and more severely than occupants of larger, heavier cars. Small cars have less structure, mass, and size to absorb crash energy; as a result higher, more injurious forces can reach their occupants in crashes. Moreover, when two small cars crash, the likelihood of occupants being killed or seriously injured is far greater than when two large cars crash.

As early as 1971, the Insurance Institute for Highway Safety was conducting crash tests to demonstrate these increased hazards for occupants of small, light cars. Since then, figures on actual deaths per registered vehicle have underscored even more forcefully the hazards of small cars.

The number of subcompacts and small subcompacts on the road has increased dramatically in the last few years, and is likely to increase further. With fuel prices high and automobile efficiency at a premium, there is little reason to think Americans will reverse their trend toward buying small, light vehicles instead of larger, safer ones. This special issue of *Status Report* focuses on the high numbers of deaths in small cars, and it examines the vital need for implementing *already available technologies* to reduce the number of people who are killed and injured every day in crashes of their subcompacts and small subcompacts.

On The Inside

- SMALLEST CARS have highest number of deaths per registered car in all kinds of crashes. ...p. 2
- JAPANESE-MADE CARS found less crashworthy than American-made in the same size group. ...p. 6
- INDICATIONS THAT JAPANESE may upgrade crashworthiness of their vehicles. ...p. 7
- STATE POLICE FILES show further hazards of small cars. ...p. 8
- TECHNOLOGY EXISTS to make *all* small cars more crashworthy. ...p. 9
- INSURER PUBLISHES special report on high number of deaths in small cars. ...p. 11

Number of Deaths Highest in Smallest Cars

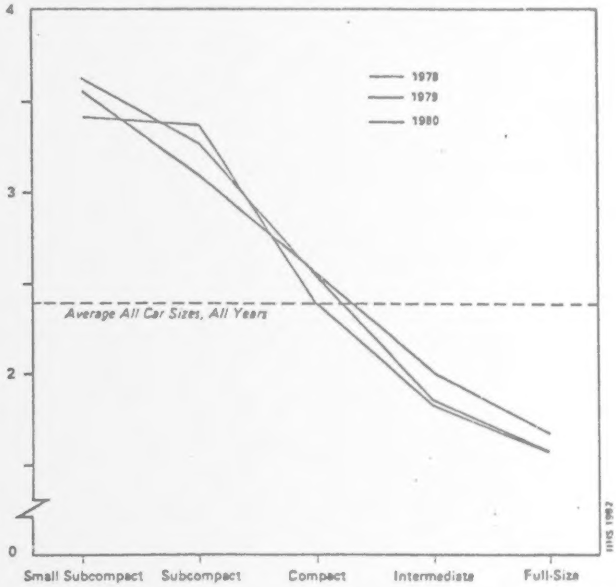
The Institute's comparison of car sizes shows 1.6 passenger car occupant deaths per 10,000 registered full-size cars* one to five years old in 1978-1980. For small subcompact cars, the number of deaths is more than twice as high – 3.5 per 10,000 cars (Figure 1).

Frontal crashes account for more than half of all passenger car occupant deaths in the United States. The number of deaths per registered small subcompact in these crashes is twice the rate for full-size cars. In all kinds of frontal crashes – single-vehicle, car-to-car, and car-to-other-vehicle – the number of deaths per small car registered is far higher than for larger cars (Figures 2 and 3).

In car-to-car crashes of all types, the discrepancy in number of deaths per car registered for large and small cars is even greater – almost three times as great in small subcompacts as in full-size cars. In side impacts, the number of deaths per car registered is 90 percent higher in the small cars.

(Cont'd on page 5)

Figure 1
Passenger Car Occupant Deaths per 10,000 Registered Cars
By Car Size, Cars 1-5 Years Old in Calendar Years 1978-1980



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* In this publication, the Institute uses five passenger car size groups, defined as follows: Small Subcompact – cars with wheelbases less than or equal to 96 in.; Subcompact – cars with wheelbases 96-101 in.; Compact – cars with wheelbases 102-111 in.; Intermediate – cars with wheelbases 112-120 in.; Full-Size – cars with wheelbases greater than 120 in.

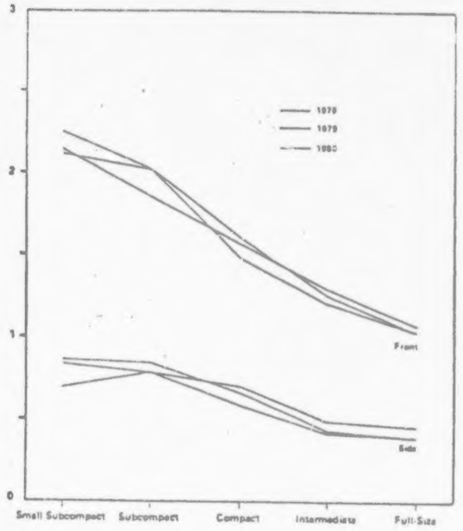


Figure 2
Passenger Car Occupant Deaths
Per 10,000 Registered Cars
By Car Size and Direction of Impact
Cars 1 to 5 Years Old
In Calendar Years 1978-1980

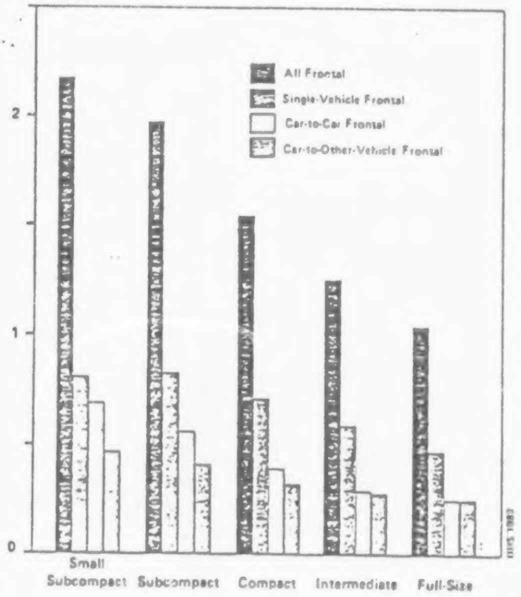


Figure 3
Passenger Car Occupant Deaths
Per 10,000 Registered Cars
In Frontal Crashes
By Car Size and Crash Type
Cars 1 to 5 Years Old
In Calendar Years 1978-1980

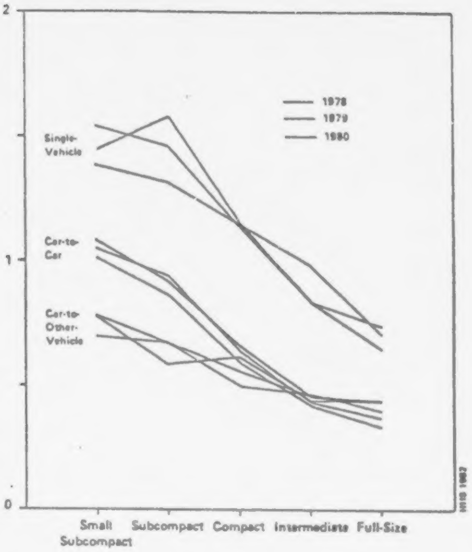


Figure 4
Passenger Car Occupant Deaths
Per 10,000 Registered Cars
By Car Size and Crash Type
Cars 1 to 5 Years Old
In Calendar Years 1978-1980

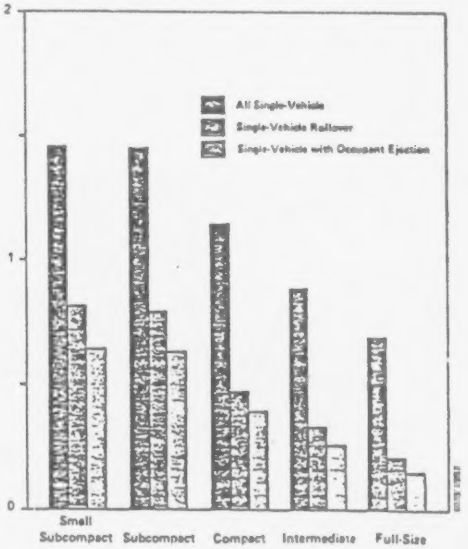


Figure 5
Passenger Car Occupant Deaths
Per 10,000 Registered Cars
In Single-Vehicle Crashes
By Car Size and Crash Type
Cars 1 to 5 Years Old
In Calendar Years 1978-1980

Number of Deaths Highest in Smallest Cars

(Cont'd from page 2)

These findings are highly consistent from year to year. The Institute has studied motor vehicle deaths by car size for all years since 1975. Nearly identical rates for 1978, 1979, and 1980 are shown in Figures 1, 2, and 4.

The results for fatalities in this publication are based on Institute analyses of national data from the Fatal Accident Reporting System (FARS), developed by the National Highway Traffic Safety Administration (NHTSA) and containing information on virtually all fatal accidents in the United States. Data obtained from police reports, motor vehicle administration files, vital statistics, and state highway department records are included in FARS. For purposes of the Institute's comparisons, all passenger car occupant fatalities during 1975-1980 occurring in cars 1-5 years old in each calendar year were examined by vehicle size group. Using these data, as well as the National Vehicle Population Profile produced by the R.L. Polk Company, the Institute calculated occupant deaths per 10,000 registered vehicles of each type.

Hazards Not Limited to Crashes with Larger Vehicles

Even if all cars on the road were small cars, the hazards of driving or riding in these vehicles would *not* be substantially alleviated, since the hazards of using small cars are not limited to crashes with larger vehicles. As shown in Figures 4 and 5, the occupants of small subcompact cars are more than twice as likely as people in full-size cars to die in single-vehicle crashes. In small subcompacts, there are almost twice as many single-vehicle *frontal* crashes with occupant fatalities per registered vehicle as in full-size cars, nearly four times as many fatal single-vehicle *rollover* crashes, and more than four times as many fatal single-vehicle crashes involving *occupant ejection*.

The incompatibility of lower, lighter cars with roadside structures designed to keep larger, heavier vehicles on the road may account in part for the high number of deaths among small car occupants in *single-vehicle* crashes. For instance, concrete barriers designed to guide straying vehicles weighing 4,000 pounds or more safely back onto the road may cause smaller ones to flip over. Similarly, posts and lamps designed to break away in crashes may not perform as intended when struck by lower, lighter cars. The National Transportation Safety Board has noted that "since the number of small front-wheel-drive vehicles is rapidly increasing. . . wheel snagging, particularly of small cars, is a problem." Citing these problems, a former Associate Administrator for Safety of the Federal Highway Administration added that "standard small sign supports can produce severe damage to both a small vehicle and vehicle occupants."

Insurance Claims Show Small Car Hazards

Like the latest death rates, the Highway Loss Data Institute's (HLDI) reports on insurance injury claims consistently have shown small cars to be associated with considerably more passenger car occupant injuries than large cars. (See *Status Report*, Vol. 16, No. 16, Oct. 20, 1981.) The smallest cars, the small subcompacts, have far more frequent first-party injury claims per insured car than full-size cars. All seventeen 1978-1980 model passenger cars with the worst insurance injury claims experience were subcompacts and small subcompacts. Of the 19 cars with the best records, none were small subcompacts; only three were subcompacts.

Domestics Outperf Japanese Models

The chance of being killed in a Japanese-made small car generally is far greater than in an American-made car of comparable size, the Institute's study of motor vehicle deaths by car size indicates. Cars made in Japan were chosen for special study because they comprise a large – and growing – part of the vehicle fleet in the United States, and because insurance claims data have shown these cars to have higher-than-average injury claim frequencies. (See *Status Report*, Vol. 16, No. 16, Oct. 20, 1981.)

Specifically, in 1978-1980 deaths per registered vehicle in Japanese small subcompact cars averaged about 40 percent higher than in cars in the same size group made in the United States. The number of deaths per registered vehicle in frontal crashes involving small subcompacts averaged 37 percent higher in Japanese cars: in single-vehicle crashes, 58 percent higher (Figure 6).

The somewhat shorter wheelbase of Japanese small subcompacts, as compared to American cars in the same size group, may in part explain the higher deaths per registered vehicle in the imported cars. But in the subcompact size group, even though Japanese- and American-built cars have approximately equal wheelbases, the number of deaths per registered vehicle for the imported models still was much worse than for the domestics (Figure 7).

Insurance Data Show Fewer Injuries in Domestics

The most recent insurance injury claims report, prepared by the Highway Loss Data Institute (HLDI), indicates that domestic car models consistently have better claims records than Japanese cars. Thirteen of the 17 cars (1978-1980 models) with the highest (i.e., worst) injury claim frequencies were made in Japan.

Figure 6
Passenger Car Occupant Deaths
Per 10,000 Registered Cars by Crash Type
Japanese- and American-made Small Subccmpacts
Cars 1 to 5 Years Old in Calendar Years 1978-1980

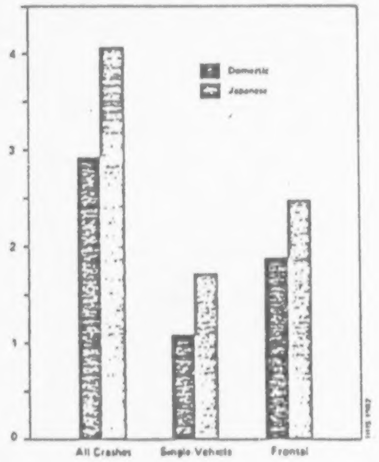
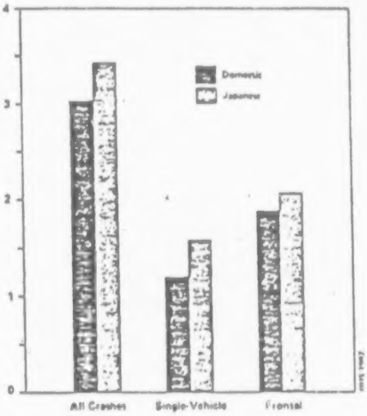


Figure 7
Passenger Car Occupant Deaths
Per 10,000 Registered Cars by Crash Type
Japanese- and American-made Subcompacts
Cars 1 to 5 Years Old in Calendar Years 1978-1980



In the three smallest car size groups, the vehicles with the worst injury claim frequencies were Japanese models: the Toyota Celica Supra (small compact), the Dodge Challenger (subcompact made by Mitsubishi), and the Datsun 200 SX (small subcompact). Conversely, in these size groups, the car with the lowest (i.e., best) insurance injury claim frequency for claims exceeding $500 was the Mercury Zephyr station wagon. The Ford Fairmont station wagon had the lowest frequency of claims exceeding $1,000 among all cars in the three smallest size groups.

Will the Japanese Make Their Cars Safer?

That's an important question, since 1978-1980 deaths per registered small car show the domestics outperforming Japanese-made cars. There are early indications, however, that this situation may change. For example:

- An executive of one of Japan's major auto companies was reported earlier this year to have said, "When you look at Japanese cars a year or two from now, I'd be very surprised if they all didn't pass the [U.S. government's] crash tests. . . . It's very unwise to have discrepancies in the crashworthiness compared to American small cars. There's no difference in technology or know-how. It's just a matter of the Japanese deciding that something has to be done, and that decision has been made." (See *Status Report*, Vol. 16, No. 6, April 27, 1981.)

- In the federal government's crash tests of 1980 cars, the Honda Civic performed poorly. After taking corrective measures, however, the Japanese company asked that their modified car be retested. The result: the Civic was one of only three models listed as having met the 30 mph injury criteria at 35 mph for both driver and front seat passenger. These results, said a U.S. official, show that "relatively minor improvements can significantly affect the test results." (See *Status Report*, Vol. 16, No. 16, Oct. 20, 1981.)

- In a Department of Transportation filing, Nissan Motor Company said it "supports any reasonable effort to reduce death and injury on the highway. We constantly observe the performance of our vehicles in the field, and are ready and willing to make product changes when an improvement in safety performance can be identified. We also devote much effort to research and development of new safety features for our vehicles. Nissan Motor Company wants our customers to have the safest possible vehicles which are at the same time reasonable to purchase and operate."

- A Japanese Ministry of Transport representative told the Eighth International Conference on Experimental Safety Vehicles, "I am in the opinion that the safety measures on the smaller vehicles problems are the most essential things to be considered. . . . We intend to cope with these problems by facilitating researches and studies, and encouraging technical developments in manufactures and to attain uniformity with international standards with our utmost efforts."

- Commenting on the federal government's recent decision to abandon plans for automatic restraints in new cars, a *New York Times* editorial concluded that "Japanese companies have overwhelmed the American market with well-finished, fuel-efficient cars. Perhaps enterprising Japanese makers will now decide that safety – or at least freedom from the jumble of shoulder belts – sells."

New Data Show Same Hazards

Data from state police-reported accident files add to the evidence that hazards in small cars are far greater than in larger vehicles. The Institute has examined these files in Maryland and North Carolina, and found that drivers of small cars are more likely to be killed or seriously injured in both frontal crashes into fixed objects and head-on crashes with other vehicles.

Specifically, in frontal crashes into fixed objects, drivers of small subcompacts during 1974-1979 were almost 40 percent more likely to be killed or seriously injured than drivers of full-size cars (Figure 8). The hazards of being in a small car were also great in head-on crashes with other cars. In Maryland, drivers of small subcompacts during 1974-1979 were almost two and a half times as likely as drivers of the largest passenger cars to be killed or seriously injured in these crashes; in North Carolina, almost twice as likely.

Data from three sources – police reports in Maryland and North Carolina, the national FARS files (see story, p. 2), and insurance claims files (see p. 5) – thus tell the same story: deaths and injuries in small cars are alarmingly high.

Figure 8
Percentage of Drivers with Serious and Fatal Injuries
In Frontal Crashes Into Fixed Objects
Model Years 1972 and Later
In Calendar Years 1974-1979

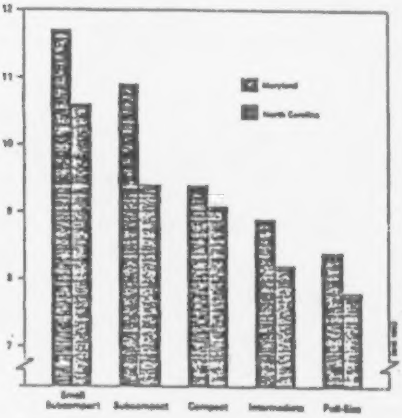
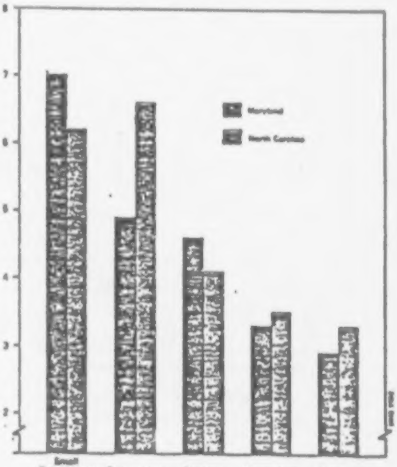


Figure 9
Percentage of Drivers with Serious and Fatal Injuries
In Head-On Crashes with Other Cars
Model Years 1972 and Later
In Calendar Years 1974-1979



Deaths In Small Cars Can Be Reduced

Small cars could provide greatly improved levels of crash protection. In fact, the quality of present cars in this respect is *far* from what could be provided.

Protecting people in small cars means implementing vehicle design changes reflecting technology that is *already available and feasible*. The time for such changes has never been more favorable. Automobiles – both domestics and imports – are undergoing sweeping overhauls of their design and manufacture; they are shrinking, losing weight, and becoming more fuel-efficient. As part of this process, long-needed improvements in occupant crash protection could be incorporated, especially since the technology for such improvements already exists.

- Seat Belts: Seat belts work; in crashes, they help keep people in cars, and reduce the violence of collisions with the vehicle's interior. But seat belts only work *if they are used*, and about 89 percent of all drivers are still traveling unrestrained. (See *Status Report*, Vol. 16, No. 9, June 24, 1981.)

- Anti-Ejection Modifications: When a person in a car is ejected in a crash, his or her body travels unprotected, often at a high rate of speed, until it is violently stopped by impacting the pavement, another vehicle, or an object on the roadside. Thus, a major priority in crash design should be to develop more effective ways to reduce the chance of occupants being ejected – that is, to keep them in the car where they can be protected by the vehicle's structure and restraint systems. But present car designs permit large numbers of occupant ejections. Designing car doors that will stay shut in crashes would go a long way toward saving people who presently are killed or severely injured when they are ejected through car doors that open during crashes. Improved glazing in side and rear windows also would reduce occupant ejections, as well as the lacerations caused by the glazing currently used.

- Steering Column Improvements: Steering column designs which automatically align with drivers' chests during crashes perform substantially better than the more commonly used telescoping designs. However, only a small number of cars have these self-aligning designs. And, unfortunately, present federal compliance test requirements for steering columns discourage the superior designs. The use of self-aligning steering columns is long overdue.

- Automatic Seat Belts: A way to protect people who do not use their manual belts is to install seat belts that automatically position themselves around front-seat occupants when they enter the car. Automatic belts currently are available in only a small percentage of cars on the road, including some Volkswagen Rabbits. The seat belt usage rate is about 80 percent in these cars, compared to only about 35 percent in Rabbits with manual belts. This difference has resulted in substantially lower occupant death rates for the models with automatic belts. Moreover, unlike manual seat belts, automatic belts must meet *specific crash test performance requirements.*

- Air Bags: In contrast to any type of belt, air bags would have a use level of virtually 100 percent from the time they are installed, since they would deploy automatically from their storage places out of sight in the steering wheel and instrument panel, to cushion occupants in a frontal crash. In more than 800 million miles of use, hundreds of actual crashes, and extensive tests by auto makers, air bag producers, and

(Cont'd on next page)

research organizations, air bags have proven to be highly effective in reducing the crash forces that cause highway deaths and injuries. Yet today, only a very few cars – none of them the small cars with alarmingly high deaths per registered vehicle – are equipped with air bags. No new cars with air bags are being offered for sale in the United States, although some are available in Europe.

- **Anti-Laceration Windshields:** Since 1968, the windshields on all new cars have been required to have a special plastic layer between the layers of glass to reduce head penetration and facial lacerations in crashes. But the layer of glass nearest the occupants still causes severe injuries. Americans suffer about 266,000 facial lacerations and 52,000 facial injuries annually in motor vehicle crashes.

An alternative windshield design, developed in Europe and already on thousands of cars there, provides an extra layer of plastic on the surface of the windshield nearest the occupants – the surface a face can strike in a frontal crash – thus effectively reducing the laceration problem. The Department of Transportation has been asked to change the applicable federal standard to permit this new windshield in the United States.

* * *

Providing needed levels of occupant protection in small cars does not need to mean adding overall weight to vehicles, or implementing technology that is prohibitively expensive or complex. The federal government already has a number of small cars, called Research Safety Vehicles (RSVs), which are lightweight and energy-efficient, and which embody most of the state-of-the-art safety engineering design concepts discussed above. In addition, some of the RSVs have energy-absorbing, foam-filled steel body structures.

This Research Safety Vehicle (RSV), built in the 1970's for the Department of Transportation by Minicars of California, weighs 2,500 pounds and is designed to protect the driver and passengers against injury in 40-50 mph frontal crashes, and in side crashes at speeds greater than 50 mph. The car has an advanced air bag system, and an innovative automotive body composed of foam-filled steel sections that absorb crash energy more effectively than conventional auto bodies. Minicars' RSV also has a soft, flexible bumper, hood, and front fenders that reduce impact forces if the car hits a pedestrian. The bumpers would not be damaged in crashes up to 10 mph.

In addition to these safety features, the RSV represents a significant improvement over conventional cars in fuel economy, getting 40-50 miles per gallon.

The purpose of the RSV program is to demonstrate to domestic and foreign automakers and the public what can be done with present technology to provide adequate occupant protection in crashes. The idea is that if manufacturers and the public know that RSV-type cars – small, stylish and, above all, relatively safe – can be produced and sold, such vehicles would start appearing in showrooms along with customers to buy them. Public and private consumer preference surveys indicate a strong potential market for vehicles with such safety improvements. (See *Status Report*, Vol. 15 (1980), Nos. 2 and 12; Vol. 14 (1979), Nos. 3 and 18; Vol. 13 (1978), No. 13; Vol. 12 (1977), No. 13; and Vol. 11 (1976), Nos. 13 and 16.)

However, the safety performance demonstrated by the RSV is not yet being provided in any small or large car commercially available in the United States. Nor has any auto manufacturer, domestic or foreign, announced its firm intention to make such technologies available in the United States new car marketplace.

Insurer Notes Deaths and Injuries in Small Cars

One of the nation's largest insurers, USAA – the United Services Automobile Association and its subsidiaries – has looked at the tragedy of deaths and injuries in small cars, and published a special issue of its magazine, *Aide*, focusing on this subject. The publication contains extensive information from the Insurance Institute for Highway Safety's analyses of deaths per registered vehicle by car size, as well as results from the Highway Loss Data Institute's latest insurance injury claims report. Special emphasis is given in USAA's publication to the great variations in deaths and injuries generated by different makes and models of small cars.

In his opening message in *Aide*, USAA's president, Robert F. McDermott, said, "Because all crashes cannot be prevented (although we should keep trying), it seems particularly important to do all we can to make automobiles more crashworthy. . . . Further, we hope manufacturers of small cars will give more emphasis to safety in the design of their cars in the future."

Reprints of the special *Aide* issue may be obtained by writing to USAA *c/o Aide*, USAA Building, San Antonio, Texas 78288.

Mr. Gore. Let me ask a couple of questions and then we will make—why don't we break now and I will come back. I have some other questions for you. We have a vote on the Floor and we will finish it up when I get back.

We will recess for 10 minutes.

[Recess.]

Mr. Gore. The subcommittee will come back to order. The recess lasted a little bit longer than I anticipated because we had two votes in a row and we had to wait for the second one to start.

Dr. Marks, your testimony states that a trap oxidizer would cost some $500 whereas the emissions control manufacturers use figures in the range of $100 to $160. That is a pretty substantial gap, isn't it?

Dr. Marks. Yes; it is.

A very large gap, and I guess my impression of the reason for that difference is largely that the emission control manufacturers have simply said the control system is the automobile manufacturer's responsibility and we think that it can be done.

In our case, we have looked at the hardware which we have tested, which does perform, although not very durably, and that hardware we have costed, and we think that in order to do that total job—any system that we have seen that has a chance even of doing it—is in that ballpark of $450 to $500.

Mr. GORE. You know, from a systems analysis point of view, it seems inefficient to attack this problem in such a segmented fashion. It would seem more reasonable to look at the entire problem as a unit and look at the steps that you have to take and the steps that the manufacturers have to take together.

Is it your testimony that the difference in the range of cost is accounted for by the emissions control folks' failure to take into account the steps you have to put into it?

Dr. MARKS. I didn't mean to imply that we don't have a systems approach to this. We are designing and building systems and doing development on them. I guess my point was that the emission control manufacturers in their work, I think, have restricted themselves to looking just at the trap materials and have not really addressed this issue—to my knowledge they have not even suggested that they know how to build a control system which will regenerate these traps automatically, as has been discussed in the hearing.

Mr. GORE. Well, let me ask you something about the Clean Air Act. I am a member of the Energy and Commerce Committee, and I know that you are more than a little aware of the debate taking place over there. Your testimony in fact makes reference to how the Clean Air Act could change NOX emission performance, but let's address another component of the bill now pending; namely the issue of technology forcing regulation.

The emissions control manufacturers have stated that without the existing standard, emission control technoogy would not be at its present level, because there would be no market and thus no incentive.

Do you agree with that?

Dr. MARKS. No; I don't, Mr. Chairman. I am glad you brought that issue up at this time. I think it is clear that there is a strong incentive to control particulate emissions from diesel vehicles just to meet the market requirements. Our customers—Mr. Shamansky reminded me a little earlier that smoke from diesel engines is undesirable. And we understand that the market for diesel engines will be limited to the extent that diesels emit smoke levels that are not desirable

So we do have a very strong incentive to reduce those emissions, regardless of the law. A particulate standard which is such that we can't meet it in a certain time framework is the real problem that we are talking about.

Mr. GORE. It is not as if you are just making diesels. The incentive is substantially modified by the fact that you are making whatever the customer buys instead of a diesel.

Dr. MARKS. I think that it is clear that if someone wants to buy a new automobile that has a diesel engine, he usually has a reason for that. He is desirous of obtaining a fuel economy which that vehicle will exhibit with the utility—the size vehicle—that he wants, and if there isn't one comparable to that, he may very well justify not buying a new car.

I don't think it is a one-to-one tradeoff, such that if you are not going to sell a diesel car you are going to sell the comparable gasoline automobile.

Mr. **Gore**. I agree with that, nor is it true that that incentive to respond to consumer preference for lower offensive odors is a sufficient incentive to force technology in and of itself.

You are not saying that it is, are you?

Dr. **Marks**. I am saying that that certainly is a driving force to get us to reduce the particulate levels of our cars, because we have a very strong incentive to sell more diesel engines.

Mr. **Gore**. Are some of the emissions that are thought to be harmful not detectable in the form of unpleasant odor?

Dr. **Marks**. I think that the general statement would be that to the extent that we are able to reduce particulate emissions in total, which are the visible as well as those components that are not necessarily as visible, we are going to reduce the harmful or potentially harmful substances.

Potentially harmful substances, after all, are absorbed on the carbon particles that are the things that you see coming out of the exhaust. So they really do go together.

Mr. **Gore**. To some extent.

Dr. **Marks**. To the extent that I am aware of, I am not aware of any emissions that are potentially harmful that aren't in that form.

Mr. **Gore**. Is it correct that you do a lot of testing of emission control devices?

Dr. **Marks**. Of course.

Mr. **Gore**. Does the EPA have access to all of those test results?

Dr. **Marks**. Yes. We provide test results of our work in this area not only to EPA, but we have provided them publicly.

Mr. **Gore**. And you do not have tests of emission control devices, the results of which have not been given to EPA?

Dr. **Marks**. Well, now, at any given time I can't tell you that there isn't something that we have tested that hasn't been made available. But we do report to EPA regularly on our emission control development program, and we have made public the developments that we have made in this area.

Mr. **Gore**. When you say you regularly report to EPA, what would regularly mean? Every few months, or——

Dr. **Marks**. There is a formal, once-a-year sort of report to EPA on emission control.

Mr. **Gore**. And those that have been filed so far, you can testify without reservation, that there are no emission control tests performed by GM, the results of which have been withheld from those annual reports to EPA?

Dr. **Marks**. I would like to add one word to that, namely, significant. I can't say that every test is reported, but I would say that there are no tests that have significantly different results from what we have reported that have been withheld.

Mr. **Gore**. Well, of course, if GM is in charge of the definition of significant, that withholding in itself could be significant. I don't know that it is, but I wonder if we might explore with you those test results which have been withheld from those annual reports. Is there a list of those at all? Could you supply that to us?

Dr. **Marks**. I guess—we would be glad to indicate to you any tests which we can identify that would not have been a part of our public submissions that we think would be pertinent.

Mr. **Gore**. Very good. Thank you very much.

[The information follows:]

General Motors provides to the Environmental Protection Agency information on our emissions system development projects in many formats throughout the course of these developmental efforts, to assure that the agency is aware of the status of these efforts and has the necessary technological assessments to make rational and reasoned judgments.

Such information is provided in responses to proposed rulemaking, to specific information requests, and in an annual review of Corporate emission system development efforts. This information exchange is a nearly continuous iterative "give and take" one in which further explanatory or supporting information is provided to the agency as required to complete its analyses.

Our submissions contain project summaries as well as detailed project results sufficient to make EPA fully knowledgable of our activities and status in all active study areas. Due to the iterative nature of experimental engineering projects, it is not necessary to provide literally all test results to objectively report on status and progress. However, we are certain that the information provided EPA initially and in ongoing discussions provides the agency a valid and current review and assessment of the status and progress of our projects. We believe no pertinent test results have been withheld from the public record on diesel particulates emission control.

Mr. **Gore**. Let me turn to what seems to be a contradiction in your testimony, and I want you to clarify it for me. You state, first, and I quote, "The trap oxidizer is the least promising technology for control." Yet in explaining other technical approaches to emission control, you state that exhaust gas recirculation "is not a desirable control approach to use."

Then you say, "A low particulate fuel has yet to be identified." And I say, "Although changes in combustion chamber configurations reduce the particulate levels to 0.4 grams particulate per million," you state, and I quote you again: "We appear to be approaching the point of diminishing returns."

If all three of those resemble a dead end, then is the trap really the least promising control technology?

Dr. **Marks**. Clearly, Mr. Chairman, that is a judgment question, and the combination of the fact that all three of those, as you have pointed out, have limitations is the reason that we do not believe that we are capable of meeting the 0.2 gram particulate standard by 1985. The fact that we have identified very severe and significant problems with durability of those trap oxidizers is what gives us to believe that that is probably the least likely to yield a resolution in that period of time.

We are still continuing to make incremental progress in combustion chamber development. There is still the potential of fuel modifications, although I think your quote left out the word practical fuel.

Mr. **Gore**. Which quote was that?

Dr. **Marks**. The quote of the fuel. You said, "there is no fuel that reduces particulate" I think we said, there is no practical fuel produced by the oil companies. At this point in time we do not feel that the fuels which have reduced particulates by up to 40 percent are practical fuels in the marketplace. That is again a judgment based upon their—the oil companies—perceptions.

So those are not dead ends in the same sense that we just can't make them work. Right now we just can't make the trap oxidizer work.

Mr. GORE. If you believe the trap oxidizer is the least promising control technique, what would you say is the most promising control technology?

Dr. MARKS. The technology that has proven to be the most effective has been combustion chamber development. As we cited, our engines have improved by almost a factor of two in emission levels in the last few years.

Mr. GORE. Well, the chamber configuration that you are talking about has achieved levels that are twice as high as what the trap oxidizer achieved in the 50,000-mile testimony on a small caliber engine, albeit at lower speeds, but that will make it appear on the surface to be further along than the chamber configuration approach if it has achieved a level half of the chamber configuration, over 50,000 miles, that makes it appear to be further along, doesn't it?

Dr. MARKS. If that were the only criteria we need meet, that would be true. Unfortunately, the trap oxidizer needs an invention which would enable us to take a measure of whether those particulate that have been collected on the trap are in sufficient quantity that they should be burned off. I don't think anyone, at this point in time, knows how to do that. And that is why we say it isn't really promising that in 2 years' time we are going to have such a system developed, because no one knows how to do that right now.

Mr. GORE. But you think that the combustion chamber configuration appears to be "approaching the point of diminishing returns." The emissions are double what has been achieved with the trap oxidizer, and if you are at a factor of two, and you are approaching the point of diminishing returns, then that doesn't appear to be very promising, does it?

Dr. MARKS. Oh, Mr. Chairman, I didn't mean to indicate—I hope I didn't imply that we think by combustion chamber development we are going to reach a 0.2 gram emission standard with the larger engines.

Mr. GORE. You are telling us that there is no hope.

Dr. MARKS. In this timeframe, I don't see that approach or any other approach meeting that standard.

Mr. GORE. The best approach would be legislative lobbying to change the relevant law?

Dr. MARKS. The diesel particulate standard is not a part of the statute at the present time and I hope that it will not become a part of the law, Mr. Chairman. I think that EPA needs the flexibility to set that standard based upon the air quality needs and the health studies, and so forth.

Mr. GORE. Well, fair enough. I appreciate the very impressive presentation that you all have made here, and I appreciate the amount of work that has gone into this, and I hope you will take your comments and questions in the spirit in which they are intended, and we wish you well, and we as a country are depending very heavily on General Motors, and particularly in this area of diesel, for our entry in this technology, and we wish you all the best, and we will be back in touch with you on the matters for the record.

Thank you very much for appearing here today. You have been very helpful.

Dr. MARKS. Thank you.

Mr. GORE. We have one final witness in today's hearing. Mr. Charles Gray is the Director of the Emission Control Technologies Division with the Office of Air, Noise, and Radiation at EPA.

Mr. Gray, we would like to welcome you as a witness at this hearing. We appreciate your patience in waiting through the long proceeding, and without objection, the entire text of your statement will be placed in the record. We invite you to summarize or to present the entire statement as you see fit.

STATEMENT OF CHARLES L. GRAY, DIRECTOR, EMISSION CONTROL TECHNOLOGY DIVISION, OFFICE OF AIR, NOISE AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Mr. GRAY. Thank you. I do welcome this opportunity to appear before the subcommittee and to discuss the issue of diesel-power vehicles, especially as they relate to the Clean Air Act and to our regulations. I will devote most of my statement to the questions you raised in the letter of invitation.

Diesel-fueled vehicles are assuming an increasing proportion of the light-duty vehicle market. Their contribution to total suspended particulate—TSP—levels and fine particulate levels is expected to increase because diesels emit about 30 to 70 times the amount of particulates emitted by catalyst-equipped gasoline vehicles.

EPA has been concerned about the projected increase in light-duty diesels—LDDs—both from the standpoint of TSP levels, since many areas still have not achieved TSP air quality standards, and from the standpoint of the unique character of diesel particulates. Diesel particulates are comprised of fine, inhalable particulates, which can be lodged deep within the lung. Regulatory actions taken by the Agency to control diesel particulates have been based upon their contribution to TSP levels.

EPA expects that between 15 and 25 percent of all new light-duty vehicles and trucks sold in the late 1980's will be powered by diesel engines, an increase of approximately 10 to 20 percent from the 1981 market penetration. Existing diesel engine manufacturers such as General Motors and Volkswagen are expanding their diesel lines and other manufacturers such as Ford and Chrysler are planning to enter the light-duty diesel market by the mid-1980s, in large part due to the increased fuel efficiency that diesel engines offer to their customers.

Therefore, given the growing number of diesels in the national fleet, EPA's task is to devise a regulatory scheme that would provide for any necessary emission controls in a way that allows cleaner diesel vehicles to be produced in a timely fashion and at a price that meets the car-buying public's needs.

In view of the projected sales increases, in March 1980 EPA established particulate emission standards for light-duty diesels. EPA considered the standards to be the lowest levels achievable by even the highest emitting LDD's with technology that could be developed within the lead time available.

Particulate emission levels from uncontrolled 1979 LDD's ranged from less than 0.3 grams per mile for small engines to more than 1.0 gpm for large engines. EPA's analysis indicated that the 1982 standard of 0.6 grams per mile could be met with fairly minor and inexpensive engine modifications. No manufacturer has had difficulty complying with that standard, and many LDDs have far surpassed it.

The 1985 standards of 0.2 gpm for passenger cars and 0.26 gpm for light-duty trucks were based on the level of control attainable with some type of exhaust treatment technology to filter out the particulates. The technology most favored by industry at that time, the trap-oxidizer, was a well understood concept but was undeveloped. By estimating the time needed for trap-oxidizer development, testing and production to be completed, EPA concluded that all LDDs could meet the standards by 1985.

EPA was petitioned by General Motors on May 5, 1980, to reconsider the 1985 particulate standard, on grounds that the required technology could not be developed in time. GM and other manufacturers also petitioned the U.S. Court of Appeals for the District of Columbia Circuit to review the rules and to direct the Agency to establish technologically feasible standards.

On June 27, 1980, EPA denied GM's petition, finding sufficient evidence that standards were feasible and indicating that reconsideration could occur at a later date if development was slower than anticipated. On April 22, 1981, the Court of Appeals denied the petition of GM and the other manufacturers. The Court upheld the standards, in part, on the basis of EPA's ability to review the industry's progress before the standards went into effect. GM unsuccessfully petitioned the U.S. Supreme Court for review of that decision.

The burden that these standards might place on an ailing automobile industry led Vice President Bush to announce on April 6, 1981 that the Task Force on Regulatory Relief, as part of President Reagan's program of actions to help the U.S. auto industry, had requested EPA to conduct a study of the technological feasibility of the 1985 standards. As a first step toward preparing the study, EPA published a request for information on June 17, 1981, and included a list of questions concerning trap-oxidizer development. Manufacturers and other interested parties were requested to respond by October 1, 1981. The information gathered currently is being reviewed and assessed by EPA.

EPA also is conducting this analysis in the context of a September 30, 1981, petition by General Motors to suspend the 1985 standards. We expect to announce the results of the study in the near future.

When EPA promulgated the diesel particulate standards, its analysis indicated that the cost effectiveness of controlling vehicle particulate emissions from vehicles compared to stationary sources was quite good. This assessment was based in part on a fairly extensive cost analysis of trap-oxidizer systems, which were estimated at the time to cost about $150 to $250. Some manufacturers have estimated higher costs, ranging upwards to about $600 for the basic system, while some trap-oxidizer manufacturers' estimates are closer to EPA's original estimate.

In an effort to reduce the potential costs to manufacturers and the attendant vehicle price increase to consumers, in December 1981, EPA proposed a program to allow averaging of LDD particulate emissions in demonstrating compliance with the 1985 standards.

The averaging program had its origin in the development of the LDD particulate standards which I discussed earlier. During the comment period on those standards, GM and Volkswagen submitted proposals for particulate averaging schemes. GM's proposal was a "corporate" average particulate standard in which a manufacturer could balance diesel particulate emissions with gasoline-fueled vehicle particulate emissions. Volkswagen's proposal was a diesel-only average standard, similar to the one that EPA proposed.

Fewer vehicles would require exhaust treatment hardware under an averaging program, saving the industry an estimated $188 to $376 million over a 5-year period. At the same time, EPA does not expect its averaging program to cause any appreciable loss of air quality benefits.

EPA also has begun to analyze the costs and benefits to be expected from the 1985 standards compared to the current standard of 0.6 gpm and other alternative standards. This analysis will attempt to quantify the benefits, as well as the costs, of controlling LDD particulate emissions to various levels.

EPA's role in establishing particulate emission standards, as well as ambient air quality standards, includes health research and technology assessment. For example, EPA regularly tests trap oxidizer systems under development to characterize their real emission impact and to remain up-to-date on technological developments.

We think that this role of monitoring the progress of technology development should continue, as should research on the health effects of diesel emissions. Finally, private industry has extensive technological expertise and we believe it is appropriate for industry to continue to develop any technology needed to control these emissions.

This concludes my prepared statement.

I might add that the various actions that I have summarized here are consistent with the National Academy of Science recommendations on the diesel particulate issue, and I would, of course, be happy to answer any questions.

Mr. GORE. Thank you very much, Mr. Gray.

I have to ask, what part of the country are you from?

Mr. GRAY. I am originally from Arkansas. I live in Michigan.

Mr. GORE. It sounded pretty close to Tennessee.

Mr. GRAY. Very close. In fact, it borders Tennessee.

Mr. GORE. Mr. Walker?

Mr. WALKER. You indicate in your study that the court of appeals has denied the petition of the manufacturers with regard to the standards and EPA's ability to review. Wasn't there also a court of appeals decision, though, which indicated that the 2-grams-per-mile particulate standard for 1985 used the wrong provision of the Clean Air Act?

Mr. GRAY. I think as discussed earlier, the final promulgation of the 0.2 standard did refer to the provision of the act that specifically requires the lowest level of control feasible without consideration of the cost or other factors, and that was referenced in the final rules.

However, as I said in my statement, the primary basis for the level that was chosen was because of technological limitations, a consideration was made with respect to the contribution of particulates to TSP levels. So in effect, the court did correct EPA in its reference to the very stringent technology forcing standard without consideration of cost provision, but did acknowledge that because of the thoroughness of that rulemaking that we did nonetheless comply with the more broad standard-setting mandate of section 202A.

Mr. WALKER. Well, what I am getting to is your statement does not mention the fact that evidently, the basis on which the standard was set, the technology forcing standard and so on was something which the court said was not appropriate use of power by EPA. The question then is why wouldn't EPA go back and use the appropriate part of the law and make a standard based upon that particular section of the law rather than using the techology forcing provision?

Mr. GRAY. Certainly it can be argued that both sections of the act are technology-forcing. The one specifically mentioned, particulate emission control in the 1977 amendments, was a technology-forcing mandate that did not really literally allow the consideration of cost. In contrast, the more broad technology-forcing aspects of 202A requires that the Administrator consider cost in setting such standards.

Mr. GORE. Would the gentleman yield?

Mr. WALKER. Yes.

Mr. GORE. The court upheld the standards and denied the appeal and then the Supreme Court denied the certiorori?

Mr. GRAY. Yes, the standards in substance were upheld, we believe in part because the court agreed we had time still to reassess the feasibility of the standard. We had continually implied that inherent in the technology forcing standard is the ability to consider the development of technology as time progresses and certainly if the technology did not evolve as we had projected, then it would be totally appropriate for a revision of some type to that standard.

Mr. WALKER. I understand the point that you are making and the point that my colleague brought out. The other point is that the court also has determined that the wrong section of the law was used in order to promulgate the regulation with regard to the 0.2-gram-per-mile standard in the first place; isn't that correct?

Mr. GRAY. We feel that we used both sections of the act, both the basic section and also the more specific reference was in the final promulgation. We do not see it as a fundamental deficiency in the final standards. But it is true that if we had relied exclusively on the specific site that was intended, according to the courts, for heavy duty diesels, then certainly we would have had to—I am sure the regulations would have been sent back to us for reproposal.

But since we did not depend exclusively on that provision, then the court basically acknowledged that we were erroneous in referencing that section, but nonetheless, it concluded that we had satisfied the requirements of the section 202A in establishing the standards.

Mr. **Walker**. But it leads to the suspicion to the 0.2-gram-per-mile standard was in fact based upon health threats, because you did utilize that, which the court says that you can't defend, and that therefore that the 0.2-gram-per-mile standard may be in fact a false standard based upon the data that you have available in order to move in an appropriate direction for 1985.

Mr. **Gray**. I think it is probably worth trying to clarify again, since it was a topic of discussion in the earlier testimony interaction. EPA set the standard because of the diesel particulate contribution to the total suspended particulate levels which have standards in terms of the maximum permissable in the ambient.

The reference to the statement that EPA made that this action was not being taken on the basis of health effects was somewhat out of context, unfortunately. It was referring to the fact that we did not set the standards on the basis of a determination that these particulates cause a significant cancer concern. We were very specifically saying that that is not—was not a determination that the Agency had made at that time.

So confusing the carcinogenic concern with the concern of the contribution to the total suspended particulate level is, I think, the primary reason for the debate and uncertainty with regard to what was intended.

Mr. **Walker**. So you are telling the committee that the 0.2 gram standard that you have set has absolutely nothing to do with health?

Mr. **Gray**. The standard was based upon public health concerns. Regulatory measures are implemented to control sources to insure that that level of particulate in the ambient—the TSP standard—is not exceeded. It is because of the diesel contribution to those suspended particulates that these standards were set. So through that path the standards were indeed set based upon consideration of health effects, not upon consideration, though, of carcinogenic effects as has been a separate concern regarding diesel particulate.

Mr. **Walker**. We are getting a couple of things confused in at least my mind here. It seems to me that the court has ruled that you could not use the technology-forcing standard, which would seem to indicate to health, and yet you are saying that you did take health considerations into effect and the 0.2 does in fact reflect a health-related concern on the part of the Agency.

Mr. **Gray**. That's correct. Under the provision in which we set standards for particulate——

Mr. **Walker**. Isn't that specifically what the court said that you couldn't use?

Mr. **Gray**. No. The section the court referred to that we cited and the court said was inappropriate to use was a very strong technology-forcing mandate——

Mr. **Walker**. Based upon health threats, right?

Mr. **Gray**. Based upon what technology could do, period.

Mr. **Walker**. But it directly references health threats; isn't that correct?

Mr. **Gray**. In the context of our implementation, the section we originally cited for the technology-forcing mandate was stronger than the general mandate in that it represented a decision on the part of Congress as far as our flexibility goes that the most stringent possible standards should be set for particulates, and it was meant to apply only to heavy duty diesel particulate. That was our misinterpretation, according to the court.

Mr. **Walker**. All right, even if you say who is determining what technology can do, you made a determination of what technology can do.

Mr. **Gray**. Definitely.

Mr. **Walker**. NAS and the manufacturers disagree with you.

Mr. **Gray**. Yes.

Mr. **Walker**. How is it that you have greater expertise than everybody else in the field and everybody else has taken a look at this?

Mr. **Gray**. First of all, this rulemaking is one of the most complex that the mobile program at EPA has had to deal with. It was so complex that the Environmental Protection Agency sponsored this very large National Academy of Sciences study that we have heard discussion about before. We contracted with the NAS to obtain a very thorough, independent assessment of this issue.

As I said, we definitely are considering the results of that study. Actions that the Agency has already taken are consistent with the conclusions and recommendations of that study. At the time these proposals were developed in 1978, through the administrative procedures process, the standards were put in place and they were clearly acknowledged in that rulemaking as technology-forcing, and that was our belief at the time of what was appropriate.

And certainly the manufacturers challenge the need for and the feasibility of those standards, and there is a considerable history of interaction on those issues, but we stand today in the process of reassessing, as recommended by the NAS, the feasibility of the 1985 standards. So I feel the Agency is being responsive to its original commitment to review the development of the technology that we projected back in the late 1970's, could be available if things went well.

Mr. **Walker**. I am concerned that it sounds like you are standing against the courts, the manufacturers, the NAS, a little bit of everybody has disagreed with where you are in terms of data, and the 0.2-grams-per-mile standard. You know, it is true Congress granted you discretionary authority, but I don't think that authority was to walk over every legal and technical expert in the field.

Mr. **Gray**. Clearly we will attempt to carry out what we understand to be the congressional mandate. The report, first of all, did not conclude that the 1985 standard was inappropriate for the level of the standard. NAS did recommend that more time was appropriate, and again, the Agency has already announced and is in the process of reconsidering that standard.

If it is appropriate, based upon the more recent evidence that we now have to change it, the Agency is committed to change it.

Mr. **Walker**. But aren't you saying that EPA is setting a standard based upon health effects, even though you can't show that there are health effects? Aren't you saying that you know more about the technical side of the thing than anybody else does, and aren't you saying that you are ignoring the health effects with regard to the totality of the committee and the U.S. auto industry in moving forward with what you are doing?

Mr. GRAY. I hope that I am not implying that that is the case, for any of those points. We believe that we, in the process of reassessing the standards, are being very responsive to the economic condition of the industry, to the fact that this was a technology-forcing standard and it is now appropriate to look again at how far that technology has moved and to make another determination as to whether or not we still believe it is feasible in an absolute sense and feasible by the time frame originally.

In that context, I would offer that we are being responsive relative to the mandate and relative to the existing situation in the auto industry.

Mr. WALKER. Mr. Chairman, you have been very generous with the time.

One final question. You say that the information that resulted from your request for a broad range of information is currently being reviewed and assessed by EPA. Do you have any kind of preliminary determinations on that?

Mr. GRAY. Well, first of all, certainly all the information obtained is in the public docket set up for this process. I think it would be appropriate to at least say that in some ways the technology, especially on engine-out levels, has progressed to a further extent than we had originally anticipated. On the other hand, the trap oxidizer technology, as a system on which the 0.2 standard admittedly was originally based, has had mixed results.

I think we would concur with the—the consensus of the previous witnesses that the primary uncertainty with respect to trap oxidizers is one's ability to have controlled regeneration of the trap.

Without controlled regeneration, it is very likely that you could have trap meltdown. Until that problem is clearly solved in such a way that the solution is production-warranted in terms of hardware, then the technology will not be available. How much time will be needed to develop a controlled regeneration system, if indeed we think it can be, is the area of difficulty that the Agency is now trying to come to grips with, and a final decision as such I think would be premature on my part.

That is where our technical analysis has lead, and it leaves us with some decisions.

Mr. WALKER. You say you expect to announce the results of your study in the near future in your testimony.

Mr. GRAY. Yes.

Mr. WALKER. Can we expect some decision on a new standard in the relatively near future if in fact you are going to go to a new standard? I wonder whether or not the determination, whether we can expect some determination as to whether or not we are going to go to a new standard and if so, what that new standard might be some time in the near future.

Mr. GRAY. Yes; the Agency has committed a very high degree of priority to addressing this issue and to providing an answer in the near future.

Mr. GORE. Mr. Gray, we have been addressing what appears to be a basic component of the determination of the regulatory policy, and that is the percentage of diesel penetration. You have said that this whole rulemaking is extremely complex and complicated and an integral part of you looking at the issue is dependent on what you think the penetration is going to be.

Nobody agrees on how many diesels we can expect to see in 1990. How are you dealing with this wide variance in the predictions, and what if the penetration is significantly less than 15 to 20 percent?

Mr. GRAY. The projections of diesel penetration have changed dramatically and very quickly over the last few years. It was probably less than 1 year ago that we were having responsible industry spokesmen predict at least a 25-percent penetration by the late 1980's. I think technically at least we feel that there will be a strong demand for high fuel efficiency vehicles in the latter part of this decade. I think we probably all hope that that wouldn't necessarily be the case because it would imply higher fuel prices and shortages.

Anticipating that we do have a finite supply of energy and that demand for fuel efficiency will continue to be strong, then we believe that the diesel engines will indeed be a very large part of the marketplace. We look at various levels in our projections of the impact, and we will continue to try to bracket what they think is a reasonable range of diesel penetration in our air quality analysis.

Mr. GORE. Well, now, the issue of test data is a significant one. You have provided the subcommittee with the data that was submitted for your proposed regulatory action and we thank you for that. Since much of this data comes from sources that can't be described as objective, what independent testing of emission control devices is available to you other than the Southwest Research study?

Mr. GRAY. We at our laboratory in Ann Arbor, Mich., do evaluate traps supplied by vendors ourselves in terms of their overall efficiency, in terms of the emission of other pollutants, unregulated pollutants, for example, and we have recently committed to evaluating some of the more promising traps at Southwest Research Institute for durability. It is primarily an effort to keep us informed but not to develop technology per se.

That represents the only independent information, independent of the manufacturers, that we have.

Mr. GORE. Are you satisfied that you have gotten all of the test results done by the auto companies?

Mr. GRAY. It is very difficult to answer that question in that not knowing in an absolute sense, we have to presume that we have. That is the only answer I can give.

Mr. GORE. All right. We are going to, thanks to the consent of General Motors, we are going to look at the nature of the data that hasn't been a part of that annual report and satisfy ourselves that it really is not significant.

Mr. GRAY. I might add on that point that in the submittals that we requested last June for the study, General Motors did provide us a much larger quantity of test data than did the other diesel engine manufacturers.

Mr. GORE. I wonder if you would be willing to answer some additional questions for the record. We have a couple of recorded votes over on the floor, and we have proceeded for quite some time. Let me ask you one additional question. Would you be willing to for the record?

Mr. **Gray**. To the extent that we can.

Mr. **Gore**. Two relatively new concerns relating to diesel emissions are visibility and odor. I say relatively new. Do you have the authority to regulate odor and visibility?

Mr. **Gray**. I do not know. I would appreciate the opportunity to follow up with a decision as coordinated with our general counsel. It is not clear to me that we do, but I don't know.

Mr. **Gore**. Without objection we will hold the record open for a more complete response to that question.

Let me thank you for appearing here today, Mr. Gray, and wish you well in your task. You have an excellent reputation at EPA and I know that you are now in the vortex of a decision that will bring you in face-to-face confrontation with a lot of pressure, and rest assured that there are many people who want to see you resist any pressure that would lead you not to make the optimum decision; so best of luck to you, and thanks to all of the witnesses who have helped us in this proceeding today.

The hearing is adjourned.

[Whereupon, at 2:20 p.m., the subcommittee adjourned.]

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